

- Intersection Capacity Analysis Worksheets

LEVEL OF SERVICE METHODOLOGY

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the 2000 Highway Capacity Manual (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements and (for signalized intersections) for the entire intersection. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements, and greater than 80 seconds for signalized movements).

Signalized Intersection Performance Measures

The six LOS designations for signalized intersections may be described as follows:

- *LOS A* describes operations with low control delay; most vehicles do not stop at all.
- *LOS B* describes operations with relatively low control delay. However, more vehicles stop than LOS A.
- *LOS C* describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- *LOS D* describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable.
- *LOS E* describes operations with high control delay values. Individual cycle failures are frequent occurrences.
- *LOS F* describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

The LOS for signalized intersections are calculated using the operational analysis methodology of the 2000 *Highway Capacity Manual*.¹ This method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on delay. LOS designations are based on the criterion of control or signal delay per vehicle. Control or signal delay is a measure of driver discomfort, frustration, and fuel consumption, and includes initial deceleration delay approaching the traffic signal, queue move-up time, stopped delay and final acceleration delay. **Table A1** summarizes the relationship between LOS and control delay. The tabulated control delay criterion may be applied in assigning LOS designations to individual lane groups, to individual intersection approaches, or to entire intersections.

Table A1
LEVEL-OF-SERVICE CRITERIA
FOR SIGNALIZED INTERSECTIONS¹

Level of Service	Control (Signal) Delay per Vehicle (Seconds)
A	≤ 10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	> 80.0

¹Source: *Highway Capacity Manual 2000*; Transportation Research Board; Washington, DC; 2000.

¹*Highway Capacity Manual 2000*; Transportation Research Board; Washington, DC; 2000.

Unsignalized Intersection Performance Measures

The six LOS designations for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.
- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach lane, with extreme control delays resulting.

The LOS designations of unsignalized intersections are determined by application of a procedure described in the 2000 *Highway Capacity Manual*.² LOS is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the effects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for LOS at unsignalized intersections are also given in the *Highway Capacity Manual 2000*. **Table A2** summarizes the relationship between LOS and average control delay.

Table A2
LEVEL-OF-SERVICE CRITERIA FOR
UNSIGNALED INTERSECTIONS¹

Level of Service	Average Control Delay (seconds per vehicle)
A	≤ 10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	>50.0

¹Source: *Highway Capacity Manual 2000*, Transportation Research Board; Washington, DC; 2000.

- Existing

HCM Unsigned Intersection Capacity Analysis
1: Patriot Way & Spring Street

2009 Existing Conditions
AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↓		↑	↑	↑	↑	↑		↑	↑	
Sign Control		Stop			Stop			Free			Free	
Grade		2%			5%			4%			-6%	
Volume (veh/h)	8	11	8	244	35	53	84	171	272	109	697	35
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	9	12	9	268	38	58	92	188	299	120	766	38
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)							6					
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1416	1696	785	1542	1566	337	804			487		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1416	1696	785	1542	1566	337	804			487		
tC, single (s)	7.2	6.9	6.4	7.1	6.6	6.3	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.4	3.5	3.5	4.1	3.4	2.2			2.2		
p0 queue free %	84	79	98	0	54	92	89			89		
cM capacity (veh/h)	53	59	365	65	83	693	811			1066		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2				
Volume Total	9	21	268	97	92	487	120	804				
Volume Left	9	0	268	0	92	0	120	0				
Volume Right	0	9	0	58	0	299	0	38				
cSH	53	91	65	209	811	1700	1066	1700				
Volume to Capacity	0.16	0.23	4.13	0.46	0.11	0.29	0.11	0.47				
Queue Length 95th (ft)	13	20	Err	56	10	0	9	0				
Control Delay (s)	85.2	56.0	Err	38.7	10.0	0.0	8.8	0.0				
Lane LOS	F	F	F	E	B		A					
Approach Delay (s)	64.6		7358.9		1.6		1.1					
Approach LOS	F		F									
Intersection Summary												
Average Delay			1416.7									
Intersection Capacity Utilization			73.6%		ICU Level of Service					D		
Analysis Period (min)			15									

Lanes, Volumes, Timings

2: Hayden Avenue & Route 2 WB on-ramp

2009 Existing Conditions
AM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	1	1	1	1	1	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	12	12
Grade (%)	-6%			3%	0%	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.970					
Flt Protected				0.987		
Satd. Flow (prot)	2067	0	0	2052	0	0
Flt Permitted				0.987		
Satd. Flow (perm)	2067	0	0	2052	0	0
Headway Factor	0.81	0.81	0.86	0.86	1.00	1.00
Link Speed (mph)	40			45	30	
Link Distance (ft)	1275			1240	500	
Travel Time (s)	21.7			18.8	11.4	
Volume (vph)	237	67	163	438	0	0
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	15%	2%	2%	0%	0%
Adj. Flow (vph)	260	74	179	481	0	0
Lane Group Flow (vph)	334	0	0	660	0	0
Sign Control	Free			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

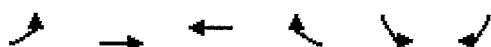
Intersection Capacity Utilization 55.3%

ICU Level of Service B

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
3: Hayden Avenue & 65 Hayden Avenue

2009 Existing Conditions
AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↖	↗		↘	↙
Sign Control		Free	Free		Stop	
Grade		2%	-2%		-2%	
Volume (veh/h)	69	137	608	18	1	5
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	79	157	699	21	1	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	720			1025	709	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
VCu, unblocked vol	720			1025	709	
tC, single (s)	4.1			6.4	6.4	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.5	
p0 queue free %	91			100	99	
CM capacity (veh/h)	887			239	405	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	237	720	7			
Volume Left	79	0	1			
Volume Right	0	21	6			
cSH	887	1700	363			
Volume to Capacity	0.09	0.42	0.02			
Queue Length 95th (ft)	7	0	1			
Control Delay (s)	3.8	0.0	15.1			
Lane LOS	A		C			
Approach Delay (s)	3.8	0.0	15.1			
Approach LOS			C			
<u>Intersection Summary</u>						
Average Delay		1.0				
Intersection Capacity Utilization		57.5%		ICU Level of Service		B
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
4: Hayden Avenue & 45 Hayden Avenue

2009 Existing Conditions
AM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↖ ↗	↑ ↘	↗ ↙	↖ ↗	↑ ↘
Sign Control		Free	Free		Stop	
Grade		2%	2%		0%	
Volume (veh/h)	33	105	621	58	3	5
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	35	112	661	62	3	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	722			873	691	
vC1, stage 1 conf vol						
vc2, stage 2 conf vol						
vcu, unblocked vol	722			873	691	
tC, single (s)	4.1			6.4	6.2	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	96			99	99	
cM capacity (veh/h)	889			310	448	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	147	722	9			
Volume Left	35	0	3			
Volume Right	0	62	5			
cSH	889	1700	384			
Volume to Capacity	0.04	0.42	0.02			
Queue Length 95th (ft)	3	0	2			
Control Delay (s)	2.5	0.0	14.6			
Lane LOS	A		B			
Approach Delay (s)	2.5	0.0	14.6			
Approach LOS			B			
Intersection Summary						
Average Delay		0.6				
Intersection Capacity Utilization		46.2%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
5: Hayden Avenue & Route 2 WB off-ramp

2009 Existing Conditions
AM Peak Hour

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑		↑	↑	↖	↖
Sign Control	Free			Free	Stop	
Grade	1%			-1%	-1%	
Volume (veh/h)	95	0	0	369	397	468
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	106	0	0	410	441	520
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						9
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume		106		516	106	
vC1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol		106		516	106	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		100		15	45	
cM capacity (veh/h)		1498		521	949	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	106	410	961			
Volume Left	0	0	441			
Volume Right	0	0	520			
cSH	1700	1700	1136			
Volume to Capacity	0.06	0.24	0.85			
Queue Length 95th (ft)	0	0	274			
Control Delay (s)	0.0	0.0	25.2			
Lane LOS			D			
Approach Delay (s)	0.0	0.0	25.2			
Approach LOS			D			
Intersection Summary						
Average Delay		16.4				
Intersection Capacity Utilization		48.1%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
6: Hayden Avenue & Waltham Street

2009 Existing Conditions
AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		1%			-1%			2%			-3%	
Volume (veh/h)	28	0	535	1	0	1	231	614	0	0	927	137
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	29	0	563	1	0	1	243	646	0	0	976	144
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)				9								
Median type		None				None						
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2109	2108	976	2108	2253	646	1120				646	
vc1, stage 1 conf vol												
vc2, stage 2 conf vol												
vcu, unblocked vol	2109	2108	976	2108	2253	646	1120				646	
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	0	100	0	0	100	100	61				100	
cm capacity (veh/h)	26	32	305	0	26	475	627				949	
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2						
Volume Total	593	2	243	646	976	144						
Volume Left	29	1	243	0	0	0						
Volume Right	563	1	0	0	0	144						
cSH	321	0	627	1700	949	1700						
Volume to Capacity	1.85	Err	0.39	0.38	0.00	0.08						
Queue Length 95th (ft)	990	Err	46	0	0	0						
Control Delay (s)	423.3	Err	14.3	0.0	0.0	0.0						
Lane LOS	F	F	B									
Approach Delay (s)	423.3	Err	3.9		0.0							
Approach LOS	F	F										
Intersection Summary												
Average Delay			Err									
Intersection Capacity Utilization		95.2%			ICU Level of Service					F		
Analysis Period (min)		15										

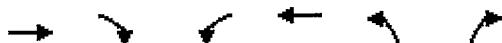
HCM Unsignalized Intersection Capacity Analysis
7: Concord Avenue & Spring Street

2009 Existing Conditions
AM Peak Hour

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖ ↗ ↘ ↗ ↙ ↘	↖ ↗ ↘ ↗ ↙ ↘	↑ ↗ ↘ ↗ ↙ ↘	↖ ↗ ↘ ↗ ↙ ↘	↖ ↗ ↘ ↗ ↙ ↘	↖ ↗ ↘ ↗ ↙ ↘
Sign Control	Stop		Free			Free
Grade	2%		2%			-2%
Volume (veh/h)	167	278	125	115	259	668
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	186	309	139	128	288	742
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1521	203			267	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	1521	203			267	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	63			78	
cM capacity (veh/h)	101	838			1297	
Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2	
Volume Total	186	309	267	288	742	
Volume Left	186	0	0	288	0	
Volume Right	0	309	128	0	0	
CSH	101	838	1700	1297	1700	
Volume to Capacity	1.83	0.37	0.16	0.22	0.44	
Queue Length 95th (ft)	378	43	0	21	0	
Control Delay (s)	480.3	11.8	0.0	8.6	0.0	
Lane LOS	F	B		A		
Approach Delay (s)	187.6		0.0	2.4		
Approach LOS	F					
Intersection Summary						
Average Delay		53.2				
Intersection Capacity Utilization		51.1%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
8: Marrett Road (Route 2A) & Spring Street

2009 Existing Conditions
AM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑		↖	↙	↘	↗
Sign Control	Free			Free	Stop	
Grade	4%			-1%	0%	
Volume (veh/h)	273	452	394	378	98	111
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	297	491	428	411	107	121
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume		788		1810	542	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol		788		1810	542	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		48		0	78	
cM capacity (veh/h)		831		42	540	

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	788	839	227
Volume Left	0	428	107
Volume Right	491	0	121
CSH	1700	831	82
Volume to Capacity	0.46	0.52	2.76
Queue Length 95th (ft)	0	75	550
Control Delay (s)	0.0	11.7	905.1
Lane LOS		B	F
Approach Delay (s)	0.0	11.7	905.1
Approach LOS			F

Intersection Summary

Average Delay	116.2		
Intersection Capacity Utilization	106.0%	ICU Level of Service	G
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
9: Marrett Road (Route 2A) & Bridge Street

2009 Existing Conditions
AM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↘	
Sign Control	Free			Free	Stop	
Grade	0%			-1%	0%	
Volume (veh/h)	384	0	0	744	28	23
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	417	0	0	809	30	25
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume		417		1226	417	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol		417		1226	417	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		100		85	96	
cM capacity (veh/h)		1142		197	635	

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	417	809	55
Volume Left	0	0	30
Volume Right	0	0	25
cSH	1700	1700	286
Volume to Capacity	0.25	0.48	0.19
Queue Length 95th (ft)	0	0	18
Control Delay (s)	0.0	0.0	20.6
Lane LOS			C
Approach Delay (s)	0.0	0.0	20.6
Approach LOS			C

Intersection Summary

Average Delay	0.9		
Intersection Capacity Utilization	49.2%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsigned Intersection Capacity Analysis
10: Shade Street & Spring Street

2009 Existing Conditions
AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	7	90	28	193	687	2
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	7	95	29	203	723	2
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	986	724	725			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	986	724	725			
tC, single (s)	6.5	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.3			
p0 queue free %	97	78	97			
cM capacity (veh/h)	252	429	855			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	102	233	725			
Volume Left	7	29	0			
Volume Right	95	0	2			
cSH	408	855	1700			
Volume to Capacity	0.25	0.03	0.43			
Queue Length 95th (ft)	24	3	0			
Control Delay (s)	16.7	1.5	0.0			
Lane LOS	C	A				
Approach Delay (s)	16.7	1.5	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			1.9			
Intersection Capacity Utilization		48.9%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
1: Patriot Way & Spring Street

2009 Existing Conditions
PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑	↑		↑	↑		↑	↑		↑	↑	
Sign Control		Stop			Stop			Free			Free	
Grade		2%			5%			4%			-6%	
Volume (veh/h)	33	56	57	111	6	130	6	492	157	40	239	2
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	36	61	62	121	7	141	7	535	171	43	260	2
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)							6					
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	899	1066	261	1072	982	620	262				705	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	899	1066	261	1072	982	620	262				705	
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	79	71	92	12	97	71	100				95	
cM capacity (veh/h)	174	212	783	136	237	487	1314				879	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2				
Volume Total	36	123	121	148	7	705	43	262				
Volume Left	36	0	121	0	7	0	43	0				
Volume Right	0	62	0	141	0	171	0	2				
cSH	174	335	136	510	1314	1700	879	1700				
Volume to Capacity	0.21	0.37	0.88	0.29	0.00	0.41	0.05	0.15				
Queue Length 95th (ft)	19	41	145	30	0	0	4	0				
Control Delay (s)	30.9	21.8	111.0	15.6	7.8	0.0	9.3	0.0				
Lane LOS	D	C	F	C	A		A					
Approach Delay (s)	23.9		58.5		0.1		1.3					
Approach LOS	C		F									
Intersection Summary												
Average Delay			13.8									
Intersection Capacity Utilization			56.8%		ICU Level of Service					B		
Analysis Period (min)			15									

Lanes, Volumes, Timings
2: Hayden Avenue & Route 2 WB on-ramp

2009 Existing Conditions
PM Peak Hour



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑		↙	↖		↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	12	12
Grade (%)	-6%			3%	0%	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.930					
Flt Protected				0.976		
Satd. Flow (prot)	2033	0	0	2039	0	0
Flt Permitted				0.976		
Satd. Flow (perm)	2033	0	0	2039	0	0
Headway Factor	0.81	0.81	0.86	0.86	1.00	1.00
Link Speed (mph)	40			45	30	
Link Distance (ft)	1275			1240	500	
Travel Time (s)	21.7			18.8	11.4	
Volume (vph)	212	227	222	225	0	0
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	3%	0%	1%	2%	0%	0%
Adj. Flow (vph)	244	261	255	259	0	0
Lane Group Flow (vph)	505	0	0	514	0	0
Sign Control	Free			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 55.8%

ICU Level of Service B

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
3: Hayden Avenue & 65 Hayden Avenue

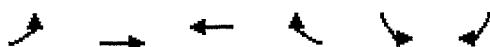
2009 Existing Conditions
PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		Y	
Sign Control		Free	Free		Stop	
Grade		2%	-2%		-2%	
Volume (veh/h)	5	216	341	7	13	73
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	235	371	8	14	79
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	378			620	374	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	378			620	374	
tC, single (s)	4.5			6.4	6.2	
tC, 2 stage (s)						
tF (s)	2.6			3.5	3.3	
p0 queue free %	99			97	88	
cM capacity (veh/h)	1000			453	676	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	240	378	93			
Volume Left	5	0	14			
Volume Right	0	8	79			
cSH	1000	1700	629			
Volume to Capacity	0.01	0.22	0.15			
Queue Length 95th (ft)	0	0	13			
Control Delay (s)	0.2	0.0	11.7			
Lane LOS	A		B			
Approach Delay (s)	0.2	0.0	11.7			
Approach LOS			B			
Intersection Summary						
Average Delay		1.6				
Intersection Capacity Utilization		30.3%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
4: Hayden Avenue & 45 Hayden Avenue

2009 Existing Conditions
PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↙	↙
Sign Control		Free	Free		Stop	
Grade		2%	2%		0%	
Volume (veh/h)	2	227	316	2	58	32
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	2	244	340	2	62	34
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	342				589	341
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	342				589	341
tC, single (s)	4.6				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.7				3.5	3.3
p0 queue free %	100				87	95
cM capacity (veh/h)	993				465	706

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	246	342	97
Volume Left	2	0	62
Volume Right	0	2	34
CSH	993	1700	529
Volume to Capacity	0.00	0.20	0.18
Queue Length 95th (ft)	0	0	17
Control Delay (s)	0.1	0.0	13.3
Lane LOS	A		B
Approach Delay (s)	0.1	0.0	13.3
Approach LOS			B

Intersection Summary

Average Delay	1.9		
Intersection Capacity Utilization	28.6%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsigned Intersection Capacity Analysis
5: Hayden Avenue & Route 2 WB off-ramp

2009 Existing Conditions
PM Peak Hour

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑		↑	↑	↖	↗
Sign Control	Free			Free	Stop	
Grade	1%			-1%	-1%	
Volume (veh/h)	339	0	0	186	93	274
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	349	0	0	192	96	282
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						9
Median type				None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume		349			541	349
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol		349			541	349
tC, single (s)		4.1			6.4	6.2
tC, 2 stage (s)						
tF (s)		2.2			3.5	3.3
p0 queue free %		100			81	59
cM capacity (veh/h)		1221			506	696
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	349	192	378			
Volume Left	0	0	96			
Volume Right	0	0	282			
cSH	1700	1700	932			
Volume to Capacity	0.21	0.11	0.41			
Queue Length 95th (ft)	0	0	50			
Control Delay (s)	0.0	0.0	13.7			
Lane LOS			B			
Approach Delay (s)	0.0	0.0	13.7			
Approach LOS			B			
Intersection Summary						
Average Delay			5.6			
Intersection Capacity Utilization		41.5%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsigneded Intersection Capacity Analysis
6: Hayden Avenue & Waltham Street

2009 Existing Conditions
PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		1%			-1%			2%			-3%	
Volume (veh/h)	104	3	506	0	0	1	144	957	1	0	654	42
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	108	3	527	0	0	1	150	997	1	0	681	44
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)				9								
Median type		None				None						
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1979	1979	681	1980	2022	997	725				998	
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1979	1979	681	1980	2022	997	725				998	
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1				4.1	
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2				2.2	
p0 queue free %	0	94	0	0	100	100	83				100	
cM capacity (veh/h)	40	52	454	0	49	299	878				701	
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2						
Volume Total	639	1	150	998	681	44						
Volume Left	108	0	150	0	0	0						
Volume Right	527	1	0	1	0	44						
cSH	183	299	878	1700	701	1700						
Volume to Capacity	3.48	0.00	0.17	0.59	0.00	0.03						
Queue Length 95th (ft)	Err	0	15	0	0	0						
Control Delay (s)	Err	17.1	9.9	0.0	0.0	0.0						
Lane LOS	F	C	A									
Approach Delay (s)	Err	17.1	1.3			0.0						
Approach LOS	F	C										
Intersection Summary												
Average Delay		2541.8										
Intersection Capacity Utilization		107.4%			ICU Level of Service					G		
Analysis Period (min)		15										

HCM Unsigned Intersection Capacity Analysis
7: Concord Avenue & Spring Street

2009 Existing Conditions
PM Peak Hour

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖ ↗ ↘ ↗ ↙ ↘	↖ ↗ ↘ ↗ ↙ ↘	↑ ↗ ↘ ↗ ↙ ↘	↖ ↗ ↘ ↗ ↙ ↘	↖ ↗ ↘ ↗ ↙ ↘	↑ ↗ ↘ ↗ ↙ ↘
Sign Control	Stop		Free			Free
Grade	2%		2%			-2%
Volume (veh/h)	119	206	474	350	116	264
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	143	248	571	422	140	318
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1380	782			993	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1380	782			993	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	37			80	
cM capacity (veh/h)	127	394			697	
Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2	
Volume Total	143	248	993	140	318	
Volume Left	143	0	0	140	0	
Volume Right	0	248	422	0	0	
cSH	127	394	1700	697	1700	
Volume to Capacity	1.13	0.63	0.58	0.20	0.19	
Queue Length 95th (ft)	211	104	0	19	0	
Control Delay (s)	185.6	28.4	0.0	11.5	0.0	
Lane LOS	F	D		B		
Approach Delay (s)	86.0		0.0	3.5		
Approach LOS	F					
Intersection Summary						
Average Delay		19.1				
Intersection Capacity Utilization		69.3%		ICU Level of Service		C
Analysis Period (min)		15				

HCM Unsigned Intersection Capacity Analysis
8: Marrett Road (Route 2A) & Spring Street

2009 Existing Conditions
PM Peak Hour



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑		↔	↔	↙	↘
Sign Control	Free			Free	Stop	
Grade	4%			-1%	0%	
Volume (veh/h)	369	189	112	226	272	360
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	405	208	123	248	299	396
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume		613		1004	509	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol		613		1004	509	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		87		0	30	
cM capacity (veh/h)		966		234	564	

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	613	371	695
Volume Left	0	123	299
Volume Right	208	0	396
cSH	1700	966	351
Volume to Capacity	0.36	0.13	1.98
Queue Length 95th (ft)	0	11	1208
Control Delay (s)	0.0	4.0	475.8
Lane LOS		A	F
Approach Delay (s)	0.0	4.0	475.8
Approach LOS			F

Intersection Summary

Average Delay	197.7		
Intersection Capacity Utilization	96.2%	ICU Level of Service	F
Analysis Period (min)	15		

HCM Unsigned Intersection Capacity Analysis
9: Marrett Road (Route 2A) & Bridge Street

2009 Existing Conditions
PM Peak Hour

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑		↑	↑	↘	↗
Sign Control	Free			Free	Stop	
Grade	0%			-1%	0%	
Volume (veh/h)	729	0	0	335	3	4
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	792	0	0	364	3	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume		792		1157	792	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vcu, unblocked vol		792		1157	792	
tC, single (s)		4.1		6.4	6.2	
tC, 2 stage (s)						
tF (s)		2.2		3.5	3.3	
p0 queue free %		100		98	99	
cM capacity (veh/h)		828		217	389	
Direction, Lane #	EB 1	WB 1	NB 1			
Volume Total	792	364	8			
Volume Left	0	0	3			
Volume Right	0	0	4			
CSH	1700	1700	290			
Volume to Capacity	0.47	0.21	0.03			
Queue Length 95th (ft)	0	0	2			
Control Delay (s)	0.0	0.0	17.7			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	17.7			
Approach LOS			C			
Intersection Summary						
Average Delay		0.1				
Intersection Capacity Utilization		48.4%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsigned Intersection Capacity Analysis
10: Shade Street & Spring Street

2009 Existing Conditions
PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	4	20	110	608	270	13
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	5	24	131	724	321	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1315	329	337			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1315	329	337			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	97	89			
cM capacity (veh/h)	157	705	1234			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	29	855	337			
Volume Left	5	131	0			
Volume Right	24	0	15			
cSH	446	1234	1700			
Volume to Capacity	0.06	0.11	0.20			
Queue Length 95th (ft)	5	9	0			
Control Delay (s)	13.6	2.6	0.0			
Lane LOS	B	A				
Approach Delay (s)	13.6	2.6	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay		2.1				
Intersection Capacity Utilization		66.4%		ICU Level of Service		C
Analysis Period (min)		15				

- No-Build

Lanes, Volumes, Timings
1: Patriot Way & Spring Street

2014 No-Build Conditions
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	12	16	12	12	12	14	12	12
Grade (%)		2%			5%			4%			-6%	
Storage Length (ft)	70		0	165		145	180		0	190		0
Storage Lanes	1		1	1		1	1		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.901				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1568	1334	1332	1684	1669	1668	1701	1644	0	1907	1938	1584
Flt Permitted	0.336			0.693			0.098			0.347		
Satd. Flow (perm)	554	1334	1332	1229	1669	1668	175	1644	0	696	1938	1584
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			59			63		178				166
Headway Factor	1.01	1.01	1.01	1.08	1.03	0.88	1.03	1.03	1.03	0.88	0.96	0.96
Link Speed (mph)		30			40			30			30	
Link Distance (ft)		1000			1275			1525			1330	
Travel Time (s)		22.7			21.7			34.7			30.2	
Volume (vph)	42	89	54	259	250	58	455	210	406	186	734	239
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	14%	41%	20%	1%	11%	7%	4%	4%	1%	4%	1%	5%
Adj. Flow (vph)	46	98	59	285	275	64	500	231	446	204	807	263
Lane Group Flow (vph)	46	98	59	285	275	64	500	677	0	204	807	263
Turn Type	Perm		Perm	Perm		Free	pm+pt		pm+pt		Perm	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		Free	2			6		6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	8.0		6.0	8.0	8.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0		11.0	13.0		11.0	13.0	13.0
Total Split (s)	24.0	24.0	24.0	24.0	24.0	0.0	25.0	55.0	0.0	11.0	41.0	41.0
Total Split (%)	26.7%	26.7%	26.7%	26.7%	26.7%	0.0%	27.8%	61.1%	0.0%	12.2%	45.6%	45.6%
Maximum Green (s)	19.0	19.0	19.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag						Lead	Lag		Lead	Lag	Lag	
Lead-Lag Optimize?						Yes	Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None	None	None	None		None	Min		None	Min	Min
Act Effct Green (s)	20.0	20.0	20.0	20.0	20.0	90.0	62.0	51.0		44.0	37.0	37.0
Actuated g/C Ratio	0.22	0.22	0.22	0.22	0.22	1.00	0.69	0.57		0.49	0.41	0.41
v/c Ratio	0.37	0.33	0.17	1.04	0.74	0.04	1.05	0.67		0.47	1.01	0.35
Control Delay	40.0	33.1	9.5	103.1	46.4	0.0	81.0	13.6		11.4	63.2	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	40.0	33.1	9.5	103.1	46.4	0.0	81.0	13.6		11.4	63.2	8.3
LOS	D	C	A	F	D	A	F	B		B	E	A

Synchro 6 Report

7/20/2009

Lanes, Volumes, Timings
1: Patriot Way & Spring Street

2014 No-Build Conditions
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		27.8			67.5			42.3			43.5	
Approach LOS		C			E			D			D	
90th %ile Green (s)	19.0	19.0	19.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Hold		Max	Max	Max
70th %ile Green (s)	19.0	19.0	19.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
70th %ile Term Code	Hold	Hold	Hold	Max	Max		Max	Hold		Max	Max	Max
50th %ile Green (s)	19.0	19.0	19.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
50th %ile Term Code	Hold	Hold	Hold	Max	Max		Max	Hold		Max	Max	Max
30th %ile Green (s)	19.0	19.0	19.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
30th %ile Term Code	Hold	Hold	Hold	Max	Max		Max	Hold		Max	Max	Max
10th %ile Green (s)	19.0	19.0	19.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
10th %ile Term Code	Hold	Hold	Hold	Max	Max		Max	Hold		Max	Max	Max
Queue Length 50th (ft)	22	47	0	~177	146	0	~264	182		35	~462	34
Queue Length 95th (ft)	58	93	31	#333	#260	0	#459	307		58	#711	87
Internal Link Dist (ft)		920			1195			1445			1250	
Turn Bay Length (ft)	70			165		145	180			190		
Base Capacity (vph)	123	296	342	273	371	1668	477	1009		434	797	749
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.37	0.33	0.17	1.04	0.74	0.04	1.05	0.67		0.47	1.01	0.35

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Natural Cycle: 80

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.05

Intersection Signal Delay: 46.7

Intersection LOS: D

Intersection Capacity Utilization 96.5%

ICU Level of Service F

Analysis Period (min) 15

90th %ile Actuated Cycle: 90

70th %ile Actuated Cycle: 90

50th %ile Actuated Cycle: 90

30th %ile Actuated Cycle: 90

10th %ile Actuated Cycle: 90

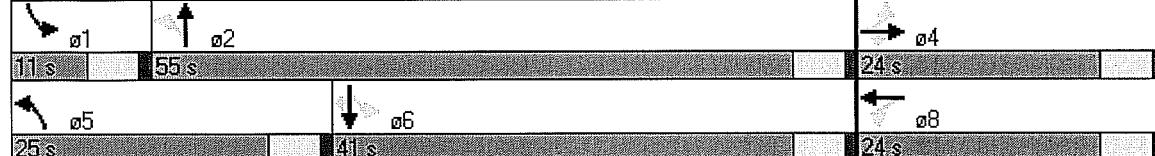
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Patriot Way & Spring Street



Lanes, Volumes, Timings
2: Hayden Avenue & Route 2 WB on-ramp

2014 No-Build Conditions
AM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↓	↙	↖	↔	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	12	12
Grade (%)	-6%			3%	0%	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.958					
Flt Protected				0.991		
Satd. Flow (prot)	2018	0	0	2061	0	0
Flt Permitted				0.991		
Satd. Flow (perm)	2018	0	0	2061	0	0
Headway Factor	0.81	0.81	0.86	0.86	1.00	1.00
Link Speed (mph)	40			45	30	
Link Distance (ft)	1275			1240	500	
Travel Time (s)	21.7			18.8	11.4	
Volume (vph)	317	141	174	794	0	0
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	15%	2%	2%	0%	0%
Adj. Flow (vph)	348	155	191	873	0	0
Lane Group Flow (vph)	503	0	0	1064	0	0
Sign Control	Free			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 83.3%

ICU Level of Service E

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
3: Hayden Avenue & 65 Hayden Avenue

2014 No-Build Conditions
AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↙	↙
Sign Control		Free	Free		Stop	
Grade		2%	-2%		-2%	
Volume (veh/h)	98	183	972	26	2	9
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	113	210	1117	30	2	10
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1147			1568	1132	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	1147			1568	1132	
tC, single (s)	4.1			6.4	6.4	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.5	
p0 queue free %	82			98	95	
cM capacity (veh/h)	613			101	228	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	323	1147	13			
Volume Left	113	0	2			
Volume Right	0	30	10			
CSH	613	1700	185			
Volume to Capacity	0.18	0.67	0.07			
Queue Length 95th (ft)	17	0	5			
Control Delay (s)	5.9	0.0	25.8			
Lane LOS	A		D			
Approach Delay (s)	5.9	0.0	25.8			
Approach LOS			D			
Intersection Summary						
Average Delay		1.5				
Intersection Capacity Utilization		81.1%		ICU Level of Service		D
Analysis Period (min)		15				

HCM Unsigned Intersection Capacity Analysis
4: Hayden Avenue & 45 Hayden Avenue

2014 No-Build Conditions
AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↑		↙	↘
Sign Control		Free	Free		Stop	
Grade		2%	2%		0%	
Volume (veh/h)	45	140	992	77	6	6
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	48	149	1055	82	6	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1137			1341	1096	
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	1137			1341	1096	
tC, single (s)	4.1			6.4	6.2	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	92			96	98	
cM capacity (veh/h)	622			157	262	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	197	1137	13			
Volume Left	48	0	6			
Volume Right	0	82	6			
cSH	622	1700	196			
Volume to Capacity	0.08	0.67	0.07			
Queue Length 95th (ft)	6	0	5			
Control Delay (s)	3.5	0.0	24.6			
Lane LOS	A		C			
Approach Delay (s)	3.5	0.0	24.6			
Approach LOS			C			
Intersection Summary						
Average Delay		0.7				
Intersection Capacity Utilization		66.9%		ICU Level of Service		C
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Hayden Avenue & Route 2 WB off-ramp

2014 No-Build Conditions
AM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↖	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16
Grade (%)	1%			-1%	-1%	
Storage Length (ft)		0	0		0	220
Storage Lanes		0	0		1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50			50	50	50
Trailing Detector (ft)	0			0	0	0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected						0.950
Satd. Flow (prot)	2060	0	0	2143	2036	1803
Flt Permitted						0.950
Satd. Flow (perm)	2060	0	0	2143	2036	1803
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)						547
Headway Factor	0.85	0.85	0.84	0.84	0.84	0.84
Link Speed (mph)	45			40	30	
Link Distance (ft)	1370			555	1000	
Travel Time (s)	20.8			9.5	22.7	
Volume (vph)	131	0	0	504	660	492
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	4%	0%	0%	1%	1%	2%
Adj. Flow (vph)	146	0	0	560	733	547
Lane Group Flow (vph)	146	0	0	560	733	547
Turn Type						Perm
Protected Phases	2			6	8	
Permitted Phases						8
Detector Phases	2			6	8	8
Minimum Initial (s)	8.0			8.0	6.0	6.0
Minimum Split (s)	13.0			13.0	11.0	11.0
Total Split (s)	26.0	0.0	0.0	26.0	34.0	34.0
Total Split (%)	43.3%	0.0%	0.0%	43.3%	56.7%	56.7%
Maximum Green (s)	21.0			21.0	29.0	29.0
Yellow Time (s)	4.0			4.0	4.0	4.0
All-Red Time (s)	1.0			1.0	1.0	1.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Recall Mode	Min			Min	None	None
Act Effct Green (s)	17.9			17.9	24.2	24.2
Actuated g/C Ratio	0.35			0.35	0.48	0.48
v/c Ratio	0.20			0.74	0.75	0.48
Control Delay	13.5			22.2	17.1	2.5
Queue Delay	0.0			0.0	0.0	0.0
Total Delay	13.5			22.2	17.1	2.5
LOS	B			C	B	A

Lanes, Volumes, Timings
5: Hayden Avenue & Route 2 WB off-ramp

2014 No-Build Conditions
AM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Approach Delay	13.5			22.2	10.9	
Approach LOS		B		C	B	
90th %ile Green (s)	21.0			21.0	29.0	29.0
90th %ile Term Code	Hold			Max	Max	Max
70th %ile Green (s)	21.0			21.0	29.0	29.0
70th %ile Term Code	Hold			Max	Max	Max
50th %ile Green (s)	20.0			20.0	27.8	27.8
50th %ile Term Code	Hold			Gap	Gap	Gap
30th %ile Green (s)	14.2			14.2	19.9	19.9
30th %ile Term Code	Hold			Gap	Gap	Gap
10th %ile Green (s)	9.1			9.1	11.8	11.8
10th %ile Term Code	Hold			Gap	Gap	Gap
Queue Length 50th (ft)	34			162	184	0
Queue Length 95th (ft)	69			270	309	40
Internal Link Dist (ft)	1290			475	920	
Turn Bay Length (ft)						220
Base Capacity (vph)	846			880	1098	1224
Starvation Cap Reductn	0			0	0	0
Spillback Cap Reductn	0			0	0	0
Storage Cap Reductn	0			0	0	0
Reduced v/c Ratio	0.17			0.64	0.67	0.45

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 50.6

Natural Cycle: 50

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.75

Intersection Signal Delay: 14.3

Intersection LOS: B

Intersection Capacity Utilization 69.8%

ICU Level of Service C

Analysis Period (min) 15

90th %ile Actuated Cycle: 60

70th %ile Actuated Cycle: 60

50th %ile Actuated Cycle: 57.8

30th %ile Actuated Cycle: 44.1

10th %ile Actuated Cycle: 30.9

Splits and Phases: 5: Hayden Avenue & Route 2 WB off-ramp



Lanes, Volumes, Timings
6: Hayden Avenue & Waltham Street

2014 No-Build Conditions
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	12	12	12	11	16	16	16	16	14
Grade (%)		1%			-1%			2%			-3%	
Storage Length (ft)	0		225	0		0	205		0	0		125
Storage Lanes	0		1	0		0	1		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.932							0.850
Flt Protected		0.950		0.976		0.950						
Satd. Flow (prot)	0	2035	1785	0	1737	0	1710	2090	0	0	2143	1714
Flt Permitted		0.757		0.859		0.100						
Satd. Flow (perm)	0	1622	1785	0	1529	0	180	2090	0	0	2143	1714
Right Turn on Red		Yes			Yes				Yes			Yes
Satd. Flow (RTOR)		405		1								163
Headway Factor	0.85	0.85	0.85	0.99	0.99	0.99	1.06	0.86	0.86	0.83	0.83	0.90
Link Speed (mph)		40		30		35						40
Link Distance (ft)		555		200			1000					1000
Travel Time (s)		9.5		4.5		19.5						17.0
Volume (vph)	46	0	575	1	0	1	289	655	0	0	974	214
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	0%	0%	2%	0%	0%	0%	1%	2%	0%	0%	2%	2%
Adj. Flow (vph)	48	0	605	1	0	1	304	689	0	0	1025	225
Lane Group Flow (vph)	0	48	605	0	2	0	304	689	0	0	1025	225
Turn Type	Perm		Free	Perm			pm+pt			Perm		Perm
Protected Phases		4			8		5	2			6	
Permitted Phases	4		Free	8			2			6		6
Detector Phases	4	4		8	8		5	2		6	6	6
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	8.0		8.0	8.0	8.0
Minimum Split (s)	11.0	11.0		11.0	11.0		10.0	13.0		13.0	13.0	13.0
Total Split (s)	11.0	11.0	0.0	11.0	11.0	0.0	14.0	54.0	0.0	40.0	40.0	40.0
Total Split (%)	16.9%	16.9%	0.0%	16.9%	16.9%	0.0%	21.5%	83.1%	0.0%	61.5%	61.5%	61.5%
Maximum Green (s)	6.0	6.0		6.0	6.0		10.0	49.0		35.0	35.0	35.0
Yellow Time (s)	4.0	4.0		4.0	4.0		3.5	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0		0.5	1.0		1.0	1.0	1.0
Lead/Lag						Lead				Lag	Lag	Lag
Lead-Lag Optimize?						Yes				Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	Min		Min	Min	Min
Act Effct Green (s)		7.0	56.8		7.0		46.9	48.9			32.6	32.6
Actuated g/C Ratio		0.11	1.00		0.11		0.83	0.86			0.57	0.57
v/c Ratio		0.26	0.34		0.01		0.72	0.38			0.83	0.21
Control Delay		30.2	0.5		23.0		25.0	2.7			19.2	3.0
Queue Delay		0.0	0.0		0.0		0.0	0.0			0.0	0.0
Total Delay		30.2	0.5		23.0		25.0	2.7			19.2	3.0
LOS		C	A		C		C	A			B	A

Synchro 6 Report
7/20/2009

Lanes, Volumes, Timings
6: Hayden Avenue & Waltham Street

2014 No-Build Conditions
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		2.7			23.0			9.5			16.3	
Approach LOS		A			C			A			B	
90th %ile Green (s)	6.0	6.0		6.0	6.0		10.0	49.0		35.0	35.0	35.0
90th %ile Term Code	Max	Max		Max	Max		Max	Hold		Max	Max	Max
70th %ile Green (s)	6.0	6.0		6.0	6.0		10.0	49.0		35.0	35.0	35.0
70th %ile Term Code	Max	Max		Hold	Hold		Max	Hold		Max	Max	Max
50th %ile Green (s)	6.0	6.0		6.0	6.0		10.0	49.0		35.0	35.0	35.0
50th %ile Term Code	Max	Max		Hold	Hold		Max	Hold		Max	Max	Max
30th %ile Green (s)	0.0	0.0		0.0	0.0		10.0	38.0		24.0	24.0	24.0
30th %ile Term Code	Skip	Skip		Skip	Skip		Max	Hold		Gap	Gap	Gap
10th %ile Green (s)	0.0	0.0		0.0	0.0		9.1	41.1		28.0	28.0	28.0
10th %ile Term Code	Skip	Skip		Skip	Skip		Gap	Dwell		Dwell	Dwell	Dwell
Queue Length 50th (ft)	18	0		0		65	64			314	10	
Queue Length 95th (ft)	47	0		6		#188	101			#578	37	
Internal Link Dist (ft)	475			120			920				920	
Turn Bay Length (ft)		225				205						125
Base Capacity (vph)	187	1785		177		426	1801			1289	1096	
Starvation Cap Reductn	0	0		0		0	0			0	0	
Spillback Cap Reductn	0	0		0		0	0			0	0	
Storage Cap Reductn	0	0		0		0	0			0	0	
Reduced v/c Ratio	0.26	0.34		0.01		0.71	0.38			0.80	0.21	

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 56.8

Natural Cycle: 65

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 10.9

Intersection LOS: B

Intersection Capacity Utilization 100.7%

ICU Level of Service G

Analysis Period (min) 15

90th %ile Actuated Cycle: 65

70th %ile Actuated Cycle: 65

50th %ile Actuated Cycle: 65

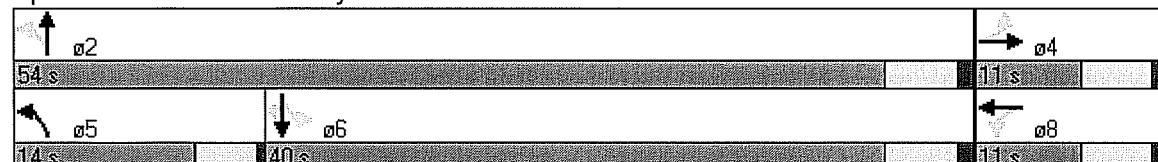
30th %ile Actuated Cycle: 43

10th %ile Actuated Cycle: 46.1

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 6: Hayden Avenue & Waltham Street



Lanes, Volumes, Timings
7: Concord Avenue & Spring Street

2014 No-Build Conditions
AM Peak Hour

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↖ ↗ ↘ ↖ ↙ ↘	↖ ↗ ↘ ↖ ↙ ↘	↖ ↗ ↘ ↖ ↙ ↘	↖ ↗ ↘ ↖ ↙ ↘	↖ ↗ ↘ ↖ ↙ ↘	↖ ↗ ↘ ↖ ↙ ↘
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	14	16	16	13	13
Grade (%)	2%		2%			-2%
Storage Length (ft)	210	0		0	230	
Storage Lanes	1	1		0	1	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850	0.949			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1810	1672	1983	0	1847	1944
Flt Permitted	0.950				0.273	
Satd. Flow (perm)	1810	1672	1983	0	531	1944
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		399	51			
Headway Factor	0.97	0.93	0.86	0.86	0.95	0.95
Link Speed (mph)	35		30			30
Link Distance (ft)	750		1000			1525
Travel Time (s)	14.6		22.7			34.7
Volume (vph)	176	741	199	121	310	714
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	196	823	221	134	344	793
Lane Group Flow (vph)	196	823	355	0	344	793
Turn Type		pt+ov		pm+pt		
Protected Phases	8	8 1	2		1	6
Permitted Phases					6	
Detector Phases	8	8 1	2		1	6
Minimum Initial (s)	6.0		8.0		6.0	8.0
Minimum Split (s)	11.0		13.0		11.0	13.0
Total Split (s)	24.0	39.0	21.0	0.0	15.0	36.0
Total Split (%)	40.0%	65.0%	35.0%	0.0%	25.0%	60.0%
Maximum Green (s)	19.0		16.0		10.0	31.0
Yellow Time (s)	4.0		4.0		4.0	4.0
All-Red Time (s)	1.0		1.0		1.0	1.0
Lead/Lag			Lag		Lead	
Lead-Lag Optimize?			Yes		Yes	
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	None		Min		None	Min
Act Effct Green (s)	15.7	30.3	13.8		28.4	28.4
Actuated g/C Ratio	0.30	0.58	0.26		0.54	0.54
v/c Ratio	0.36	0.73	0.63		0.63	0.75
Control Delay	16.9	8.5	21.3		13.3	16.2
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	16.9	8.5	21.3		13.3	16.2
LOS	B	A	C		B	B
Approach Delay	10.1		21.3			15.3

Lanes, Volumes, Timings
7: Concord Avenue & Spring Street

2014 No-Build Conditions
AM Peak Hour

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Approach LOS	B		C			B
90th %ile Green (s)	19.0		16.0		10.0	31.0
90th %ile Term Code	Max		Max		Max	Max
70th %ile Green (s)	19.0		16.0		10.0	31.0
70th %ile Term Code	Max		Max		Max	Max
50th %ile Green (s)	19.0		14.1		10.0	29.1
50th %ile Term Code	Max		Gap		Max	Hold
30th %ile Green (s)	12.3		10.5		10.0	25.5
30th %ile Term Code	Gap		Gap		Max	Hold
10th %ile Green (s)	6.5		8.0		6.5	19.5
10th %ile Term Code	Gap		Min		Gap	Hold
Queue Length 50th (ft)	49	68	93		65	205
Queue Length 95th (ft)	98	201	168		112	#340
Internal Link Dist (ft)	670		920			1445
Turn Bay Length (ft)	210				230	
Base Capacity (vph)	648	1185	652		562	1118
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.30	0.69	0.54		0.61	0.71

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 52.4

Natural Cycle: 50

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.75

Intersection Signal Delay: 14.0

Intersection LOS: B

Intersection Capacity Utilization 70.4%

ICU Level of Service C

Analysis Period (min) 15

90th %ile Actuated Cycle: 60

70th %ile Actuated Cycle: 60

50th %ile Actuated Cycle: 58.1

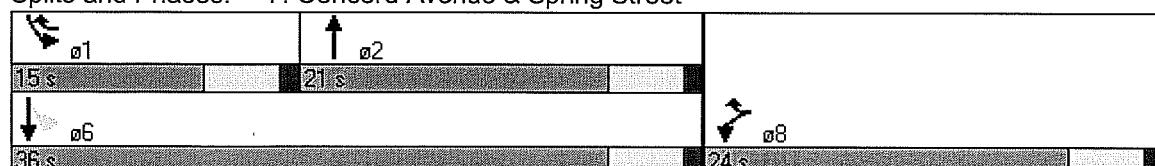
30th %ile Actuated Cycle: 47.8

10th %ile Actuated Cycle: 36

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 7: Concord Avenue & Spring Street



Lanes, Volumes, Timings
8: Marrett Road (Route 2A) & Spring Street

2014 No-Build Conditions
AM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→ ↘ ↗ ↙ ↖ ↗					
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	13	13
Grade (%)	4%			-1%	0%	
Storage Length (ft)		0	200		0	0
Storage Lanes		0	1		1	0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50	50	50	
Trailing Detector (ft)	0		0	0	0	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.908				0.931	
Flt Protected			0.950		0.976	
Satd. Flow (prot)	1879	0	2016	2122	1749	0
Flt Permitted			0.129		0.976	
Satd. Flow (perm)	1879	0	274	2122	1749	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	236				72	
Headway Factor	0.87	0.87	0.84	0.84	0.96	0.96
Link Speed (mph)	30			30	30	
Link Distance (ft)	1000			1000	2795	
Travel Time (s)	22.7			22.7	63.5	
Volume (vph)	287	621	542	397	127	132
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	312	675	589	432	138	143
Lane Group Flow (vph)	987	0	589	432	281	0
Turn Type		pm+pt				
Protected Phases	2		1	6	8	
Permitted Phases			6			
Detector Phases	2		1	6	8	
Minimum Initial (s)	8.0		6.0	8.0	6.0	
Minimum Split (s)	13.0		11.0	13.0	11.0	
Total Split (s)	31.0	0.0	17.0	48.0	12.0	0.0
Total Split (%)	51.7%	0.0%	28.3%	80.0%	20.0%	0.0%
Maximum Green (s)	26.0		12.0	43.0	7.0	
Yellow Time (s)	4.0		4.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	1.0	1.0	
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Recall Mode	Min		None	Min	None	
Act Effct Green (s)	27.0		44.0	44.0	8.0	
Actuated g/C Ratio	0.45		0.73	0.73	0.13	
v/c Ratio	1.01		1.02	0.28	0.95	
Control Delay	47.8		60.6	3.2	64.8	
Queue Delay	0.0		0.0	0.0	0.0	
Total Delay	47.8		60.6	3.2	64.8	
LOS	D		E	A	E	
Approach Delay	47.8			36.3	64.8	

Lanes, Volumes, Timings
8: Marrett Road (Route 2A) & Spring Street

2014 No-Build Conditions
AM Peak Hour



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Approach LOS	D			D	E	
90th %ile Green (s)	26.0		12.0	43.0	7.0	
90th %ile Term Code	Max		Max	Hold	Max	
70th %ile Green (s)	26.0		12.0	43.0	7.0	
70th %ile Term Code	Max		Max	Hold	Max	
50th %ile Green (s)	26.0		12.0	43.0	7.0	
50th %ile Term Code	Max		Max	Hold	Max	
30th %ile Green (s)	26.0		12.0	43.0	7.0	
30th %ile Term Code	Max		Max	Hold	Max	
10th %ile Green (s)	26.0		12.0	43.0	7.0	
10th %ile Term Code	Max		Max	Hold	Max	
Queue Length 50th (ft)	~287		~160	38	76	
Queue Length 95th (ft)	#545		#351	62	#210	
Internal Link Dist (ft)	920			920	2715	
Turn Bay Length (ft)			200			
Base Capacity (vph)	975		578	1556	296	
Starvation Cap Reductn	0		0	0	0	
Spillback Cap Reductn	0		0	0	0	
Storage Cap Reductn	0		0	0	0	
Reduced v/c Ratio	1.01		1.02	0.28	0.95	

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 60

Natural Cycle: 55

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.02

Intersection Signal Delay: 44.8

Intersection LOS: D

Intersection Capacity Utilization 108.4%

ICU Level of Service G

Analysis Period (min) 15

90th %ile Actuated Cycle: 60

70th %ile Actuated Cycle: 60

50th %ile Actuated Cycle: 60

30th %ile Actuated Cycle: 60

10th %ile Actuated Cycle: 60

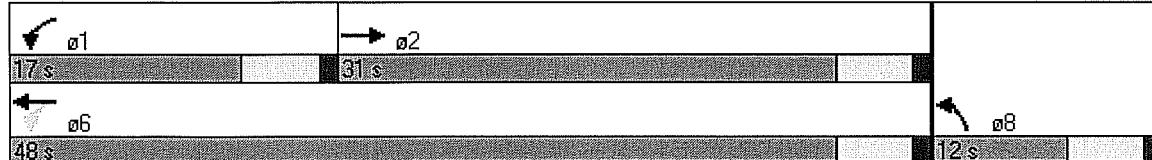
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 8: Marrett Road (Route 2A) & Spring Street



HCM Unsigned Intersection Capacity Analysis
10: Shade Street & Spring Street

2014 No-Build Conditions
AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	7	95	29	242	996	2
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	7	100	31	255	1048	2
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1365	1049	1051			
VC1, stage 1 conf vol						
VC2, stage 2 conf vol						
vCu, unblocked vol	1365	1049	1051			
tC, single (s)	6.5	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.3			
p0 queue free %	95	64	95			
cM capacity (veh/h)	146	279	644			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	107	285	1051			
Volume Left	7	31	0			
Volume Right	100	0	2			
cSH	262	644	1700			
Volume to Capacity	0.41	0.05	0.62			
Queue Length 95th (ft)	47	4	0			
Control Delay (s)	27.9	1.7	0.0			
Lane LOS	D	A				
Approach Delay (s)	27.9	1.7	0.0			
Approach LOS	D					
Intersection Summary						
Average Delay			2.4			
Intersection Capacity Utilization		65.5%		ICU Level of Service		C
Analysis Period (min)		15				

Lanes, Volumes, Timings
1: Patriot Way & Spring Street

2014 No-Build Conditions
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	12	16	12	12	12	14	12	12
Grade (%)		2%			5%			4%			-6%	
Storage Length (ft)	70		0	165		145	180		0	190		0
Storage Lanes	1		1	1		1	1		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.961				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1787	1881	1599	1684	1853	1750	1769	1767	0	1889	1957	1663
Flt Permitted	0.714			0.300			0.514			0.103		
Satd. Flow (perm)	1343	1881	1599	532	1853	1750	957	1767	0	205	1957	1663
Right Turn on Red			Yes			Yes			Yes		Yes	
Satd. Flow (RTOR)			272			176		25				52
Headway Factor	1.01	1.01	1.01	1.08	1.03	0.88	1.03	1.03	1.03	0.88	0.96	0.96
Link Speed (mph)		30			40			30			30	
Link Distance (ft)		1000			1275			1525			1330	
Travel Time (s)		22.7			21.7			34.7			30.2	
Volume (vph)	181	384	250	169	61	162	89	521	183	46	251	48
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	0%	1%	2%	5%	0%	0%
Adj. Flow (vph)	197	417	272	184	66	176	97	566	199	50	273	52
Lane Group Flow (vph)	197	417	272	184	66	176	97	765	0	50	273	52
Turn Type	Perm		pm+ov	Perm			Free	pm+pt		pm+pt		Perm
Protected Phases		4	5		8			5	2		1	6
Permitted Phases	4		4	8		Free	2			6		6
Detector Phases	4	4	5	8	8		5	2		1	6	6
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	8.0		6.0	8.0	8.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0		11.0	13.0		11.0	13.0	13.0
Total Split (s)	36.0	36.0	11.0	36.0	36.0	0.0	11.0	43.0	0.0	11.0	43.0	43.0
Total Split (%)	40.0%	40.0%	12.2%	40.0%	40.0%	0.0%	12.2%	47.8%	0.0%	12.2%	47.8%	47.8%
Maximum Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		6.0	38.0	38.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag			Lead				Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None	None	None	None		None	Min		None	Min	Min
Act Effct Green (s)	31.7	31.7	42.8	31.7	31.7	84.3	42.2	38.3		40.6	33.4	33.4
Actuated g/C Ratio	0.38	0.38	0.51	0.38	0.38	1.00	0.50	0.45		0.46	0.40	0.40
v/c Ratio	0.39	0.59	0.29	0.92	0.09	0.10	0.18	0.94		0.22	0.35	0.08
Control Delay	23.6	26.5	2.7	76.8	19.4	0.1	10.6	43.4		12.2	18.9	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	23.6	26.5	2.7	76.8	19.4	0.1	10.6	43.4		12.2	18.9	4.8
LOS	C	C	A	E	B	A	B	D		B	B	A

Synchro 6 Report

7/20/2009

Lanes, Volumes, Timings
1: Patriot Way & Spring Street

2014 No-Build Conditions
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		18.5			36.2			39.7			16.1	
Approach LOS		B			D			D			B	
90th %ile Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		6.0	38.0	38.0
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Max		Max	Hold	Hold
70th %ile Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		6.0	38.0	38.0
70th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Max		Max	Hold	Hold
50th %ile Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		6.0	38.0	38.0
50th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Max		Max	Hold	Hold
30th %ile Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		0.0	27.0	27.0
30th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Max		Skip	Hold	Hold
10th %ile Green (s)	28.8	28.8	6.0	28.8	28.8		6.0	33.7		0.0	22.7	22.7
10th %ile Term Code	Hold	Hold	Max	Gap	Gap		Max	Gap		Skip	Hold	Hold
Queue Length 50th (ft)	83	194	0	102	25	0	24	406		12	99	0
Queue Length 95th (ft)	145	293	40	#237	53	0	47	#663		28	158	20
Internal Link Dist (ft)		920			1195			1445			1250	
Turn Bay Length (ft)	70			165		145	180			190		
Base Capacity (vph)	511	715	946	202	704	1750	547	827		227	852	754
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.39	0.58	0.29	0.91	0.09	0.10	0.18	0.93		0.22	0.32	0.07

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 84.3

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.94

Intersection Signal Delay: 28.3

Intersection LOS: C

Intersection Capacity Utilization 86.5%

ICU Level of Service E

Analysis Period (min) 15

90th %ile Actuated Cycle: 90

70th %ile Actuated Cycle: 90

50th %ile Actuated Cycle: 90

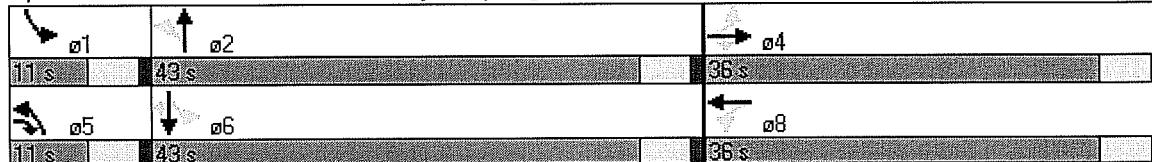
30th %ile Actuated Cycle: 79

10th %ile Actuated Cycle: 72.5

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Patriot Way & Spring Street



Lanes, Volumes, Timings
2: Hayden Avenue & Route 2 WB on-ramp

2014 No-Build Conditions
PM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↓	↙	↖	↔	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	12	12
Grade (%)	-6%			3%	0%	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.919					
Flt Protected				0.978		
Satd. Flow (prot)	2014	0	0	2043	0	0
Flt Permitted				0.978		
Satd. Flow (perm)	2014	0	0	2043	0	0
Headway Factor	0.81	0.81	0.86	0.86	1.00	1.00
Link Speed (mph)	40			45	30	
Link Distance (ft)	1275			1240	500	
Travel Time (s)	21.7			18.8	11.4	
Volume (vph)	401	606	252	321	0	0
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	3%	0%	1%	2%	0%	0%
Adj. Flow (vph)	461	697	290	369	0	0
Lane Group Flow (vph)	1158	0	0	659	0	0
Sign Control	Free			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 95.8%

ICU Level of Service F

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
3: Hayden Avenue & 65 Hayden Avenue

2014 No-Build Conditions
PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↖	↙
Sign Control		Free	Free		Stop	
Grade		2%	-2%		-2%	
Volume (veh/h)	10	400	438	8	20	97
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	435	476	9	22	105
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	485			937	480	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	485			937	480	
tC, single (s)	4.5			6.4	6.2	
tC, 2 stage (s)						
tF (s)	2.6			3.5	3.3	
p0 queue free %	99			93	82	
cM capacity (veh/h)	907			293	590	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	446	485	127			
Volume Left	11	0	22			
Volume Right	0	9	105			
cSH	907	1700	503			
Volume to Capacity	0.01	0.29	0.25			
Queue Length 95th (ft)	1	0	25			
Control Delay (s)	0.4	0.0	14.6			
Lane LOS	A		B			
Approach Delay (s)	0.4	0.0	14.6			
Approach LOS			B			
Intersection Summary						
Average Delay		1.9				
Intersection Capacity Utilization		42.9%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis
4: Hayden Avenue & 45 Hayden Avenue

2014 No-Build Conditions
PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↖	↗
Sign Control		Free	Free		Stop	
Grade		2%	2%		0%	
Volume (veh/h)	4	416	404	6	74	42
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	4	447	434	6	80	45
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	441			894	438	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	441			894	438	
tC, single (s)	4.6			6.4	6.2	
tC, 2 stage (s)						
tF (s)	2.7			3.5	3.3	
p0 queue free %	100			74	93	
cM capacity (veh/h)	906			307	623	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	452	441	125			
Volume Left	4	0	80			
Volume Right	0	6	45			
cSH	906	1700	376			
Volume to Capacity	0.00	0.26	0.33			
Queue Length 95th (ft)	0	0	36			
Control Delay (s)	0.1	0.0	19.3			
Lane LOS	A		C			
Approach Delay (s)	0.1	0.0	19.3			
Approach LOS			C			
Intersection Summary						
Average Delay		2.4				
Intersection Capacity Utilization		38.4%		ICU Level of Service		A
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Hayden Avenue & Route 2 WB off-ramp

2014 No-Build Conditions
PM Peak Hour

	→	↘	↙	←	↗	↗
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↑	↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16
Grade (%)	1%			-1%	-1%	
Storage Length (ft)		0	0		0	220
Storage Lanes		0	0		1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50			50	50	50
Trailing Detector (ft)	0			0	0	0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected						0.950
Satd. Flow (prot)	2121	0	0	2122	2056	1821
Flt Permitted						0.950
Satd. Flow (perm)	2121	0	0	2122	2056	1821
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)						142
Headway Factor	0.85	0.85	0.84	0.84	0.84	0.84
Link Speed (mph)	45			40	30	
Link Distance (ft)	1370			555	1000	
Travel Time (s)	20.8			9.5	22.7	
Volume (vph)	550	0	0	220	148	288
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	0%	0%	2%	0%	1%
Adj. Flow (vph)	567	0	0	227	153	297
Lane Group Flow (vph)	567	0	0	227	153	297
Turn Type						Perm
Protected Phases	2			6	8	
Permitted Phases						8
Detector Phases	2			6	8	8
Minimum Initial (s)	8.0			8.0	6.0	6.0
Minimum Split (s)	13.0			13.0	11.0	11.0
Total Split (s)	26.0	0.0	0.0	26.0	34.0	34.0
Total Split (%)	43.3%	0.0%	0.0%	43.3%	56.7%	56.7%
Maximum Green (s)	21.0			21.0	29.0	29.0
Yellow Time (s)	4.0			4.0	4.0	4.0
All-Red Time (s)	1.0			1.0	1.0	1.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Recall Mode	Min			Min	None	None
Act Effct Green (s)	20.1			20.1	10.3	10.3
Actuated g/C Ratio	0.57			0.57	0.28	0.28
v/c Ratio	0.47			0.19	0.27	0.49
Control Delay	8.4			6.3	11.2	8.8
Queue Delay	0.0			0.0	0.0	0.0
Total Delay	8.4			6.3	11.2	8.8
LOS	A			A	B	A

Lanes, Volumes, Timings
5: Hayden Avenue & Route 2 WB off-ramp

2014 No-Build Conditions
PM Peak Hour



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Approach Delay	8.4			6.3	9.6	
Approach LOS		A		A	A	
90th %ile Green (s)	21.0			21.0	15.3	15.3
90th %ile Term Code	Max			Hold	Gap	Gap
70th %ile Green (s)	17.9			17.9	10.5	10.5
70th %ile Term Code	Gap			Hold	Gap	Gap
50th %ile Green (s)	13.5			13.5	8.1	8.1
50th %ile Term Code	Gap			Hold	Gap	Gap
30th %ile Green (s)	10.8			10.8	6.5	6.5
30th %ile Term Code	Gap			Hold	Gap	Gap
10th %ile Green (s)	26.9			26.9	0.0	0.0
10th %ile Term Code	Dwell			Dwell	Skip	Skip
Queue Length 50th (ft)	60			20	19	19
Queue Length 95th (ft)	170			63	58	72
Internal Link Dist (ft)	1290			475	920	
Turn Bay Length (ft)						220
Base Capacity (vph)	1338			1339	1092	1034
Starvation Cap Reductn	0			0	0	0
Spillback Cap Reductn	0			0	0	0
Storage Cap Reductn	0			0	0	0
Reduced v/c Ratio	0.42			0.17	0.14	0.29

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 35.1

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.49

Intersection Signal Delay: 8.5

Intersection LOS: A

Intersection Capacity Utilization 53.4%

ICU Level of Service A

Analysis Period (min) 15

90th %ile Actuated Cycle: 46.3

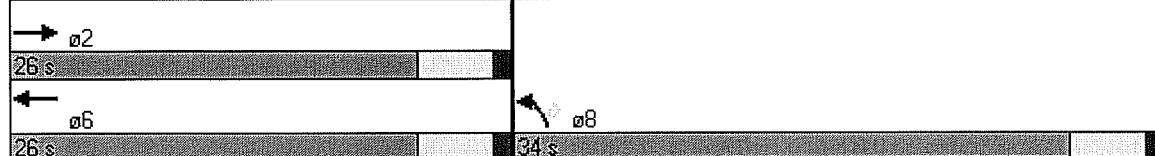
70th %ile Actuated Cycle: 38.4

50th %ile Actuated Cycle: 31.6

30th %ile Actuated Cycle: 27.3

10th %ile Actuated Cycle: 31.9

Splits and Phases: 5: Hayden Avenue & Route 2 WB off-ramp



Lanes, Volumes, Timings
6: Hayden Avenue & Waltham Street

2014 No-Build Conditions
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	12	12	12	11	16	16	16	16	14
Grade (%)		1%			-1%			2%			-3%	
Storage Length (ft)	0		225	0		0	205		0	0		125
Storage Lanes	0		1	0		0	1		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.865							0.850
Flt Protected		0.953					0.950					
Satd. Flow (prot)	0	2042	1821	0	1652	0	1694	2111	0	0	2164	1714
Flt Permitted		0.729					0.133					
Satd. Flow (perm)	0	1562	1821	0	1652	0	237	2111	0	0	2164	1714
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			535		128							58
Headway Factor	0.85	0.85	0.85	0.99	0.99	0.99	1.06	0.86	0.86	0.83	0.83	0.90
Link Speed (mph)		40			30		35					40
Link Distance (ft)		555			200		1000					1000
Travel Time (s)		9.5			4.5		19.5					17.0
Volume (vph)	212	3	623	0	0	1	160	1014	1	0	688	60
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	1%	0%	0%	1%	2%
Adj. Flow (vph)	221	3	649	0	0	1	167	1056	1	0	717	62
Lane Group Flow (vph)	0	224	649	0	1	0	167	1057	0	0	717	62
Turn Type	Perm		Free	Perm			pm+pt			Perm		Perm
Protected Phases		4			8		5	2			6	
Permitted Phases	4		Free	8			2			6		6
Detector Phases	4	4		8	8		5	2		6	6	6
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	8.0		8.0	8.0	8.0
Minimum Split (s)	11.0	11.0		11.0	11.0		10.0	13.0		13.0	13.0	13.0
Total Split (s)	17.0	17.0	0.0	17.0	17.0	0.0	11.0	43.0	0.0	32.0	32.0	32.0
Total Split (%)	28.3%	28.3%	0.0%	28.3%	28.3%	0.0%	18.3%	71.7%	0.0%	53.3%	53.3%	53.3%
Maximum Green (s)	12.0	12.0		12.0	12.0		7.0	38.0		27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		3.5	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0		0.5	1.0		1.0	1.0	1.0
Lead/Lag						Lead			Lag	Lag	Lag	
Lead-Lag Optimize?						Yes			Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	Min		Min	Min	Min
Act Effct Green (s)		11.8	56.0		11.8		36.2	36.2			27.5	27.5
Actuated g/C Ratio		0.21	1.00		0.21		0.62	0.65			0.49	0.49
v/c Ratio		0.68	0.36		0.00		0.52	0.77			0.68	0.07
Control Delay		32.8	0.5		0.0		11.9	12.3			16.2	3.5
Queue Delay		0.0	0.0		0.0		0.0	0.0			0.0	0.0
Total Delay		32.8	0.5		0.0		11.9	12.3			16.2	3.5
LOS		C	A		A		B	B			B	A

Synchro 6 Report
7/20/2009

Lanes, Volumes, Timings
6: Hayden Avenue & Waltham Street

2014 No-Build Conditions
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		8.8			0.0			12.3			15.2	
Approach LOS		A			A			B			B	
90th %ile Green (s)	12.0	12.0		12.0	12.0		7.0	38.0		27.0	27.0	27.0
90th %ile Term Code	Max	Max		Hold	Hold		Max	Max		Max	Max	Max
70th %ile Green (s)	12.0	12.0		12.0	12.0		7.0	38.0		27.0	27.0	27.0
70th %ile Term Code	Max	Max		Hold	Hold		Max	Max		Max	Max	Max
50th %ile Green (s)	12.0	12.0		12.0	12.0		7.0	35.0		24.0	24.0	24.0
50th %ile Term Code	Max	Max		Hold	Hold		Max	Hold		Gap	Gap	Gap
30th %ile Green (s)	10.6	10.6		10.6	10.6		7.0	29.6		18.6	18.6	18.6
30th %ile Term Code	Gap	Gap		Hold	Hold		Max	Hold		Gap	Gap	Gap
10th %ile Green (s)	7.4	7.4		7.4	7.4		0.0	35.3		35.3	35.3	35.3
10th %ile Term Code	Gap	Gap		Hold	Hold		Skip	Dwell		Dwell	Dwell	Dwell
Queue Length 50th (ft)	69	0		0			19	221			193	1
Queue Length 95th (ft)	#159	0		0			55	372			308	17
Internal Link Dist (ft)	475			120				920			920	
Turn Bay Length (ft)		225					205					125
Base Capacity (vph)	356	1821		476			324	1401			1111	908
Starvation Cap Reductn	0	0		0			0	0			0	0
Spillback Cap Reductn	0	0		0			0	0			0	0
Storage Cap Reductn	0	0		0			0	0			0	0
Reduced v/c Ratio	0.63	0.36		0.00			0.52	0.75			0.65	0.07

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 56

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.77

Intersection Signal Delay: 12.0

Intersection LOS: B

Intersection Capacity Utilization 118.2%

ICU Level of Service H

Analysis Period (min) 15

90th %ile Actuated Cycle: 60

70th %ile Actuated Cycle: 60

50th %ile Actuated Cycle: 57

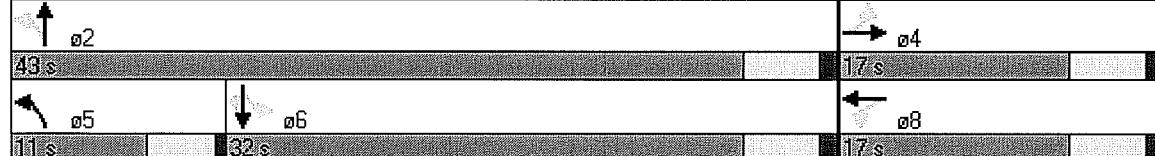
30th %ile Actuated Cycle: 50.2

10th %ile Actuated Cycle: 52.7

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 6: Hayden Avenue & Waltham Street



Lanes, Volumes, Timings
7: Concord Avenue & Spring Street

2014 No-Build Conditions
PM Peak Hour

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↑ ↗ ↘ ↑ ↙ ↘	↑ ↗ ↘ ↑ ↙ ↘	↑ ↗ ↘ ↑ ↙ ↘	↑ ↗ ↘ ↑ ↙ ↘	↑ ↗ ↘ ↑ ↙ ↘	↑ ↗ ↘ ↑ ↙ ↘
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	14	16	16	13	13
Grade (%)	2%		2%			-2%
Storage Length (ft)	210	0		0	230	
Storage Lanes	1	1		0	1	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850	0.944			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1810	1672	1973	0	1847	1944
Flt Permitted	0.950				0.091	
Satd. Flow (perm)	1810	1672	1973	0	177	1944
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		268	86			
Headway Factor	0.97	0.93	0.86	0.86	0.95	0.95
Link Speed (mph)	35		30			30
Link Distance (ft)	750		1000			1525
Travel Time (s)	14.6		22.7			34.7
Volume (vph)	125	309	511	368	307	337
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	151	372	616	443	370	406
Lane Group Flow (vph)	151	372	1059	0	370	406
Turn Type		pt+ov		pm+pt		
Protected Phases	8	8 1	2		1	6
Permitted Phases					6	
Detector Phases	8	8 1	2		1	6
Minimum Initial (s)	6.0		8.0		6.0	8.0
Minimum Split (s)	11.0		13.0		11.0	13.0
Total Split (s)	11.0	26.0	44.0	0.0	15.0	59.0
Total Split (%)	15.7%	37.1%	62.9%	0.0%	21.4%	84.3%
Maximum Green (s)	6.0		39.0		10.0	54.0
Yellow Time (s)	4.0		4.0		4.0	4.0
All-Red Time (s)	1.0		1.0		1.0	1.0
Lead/Lag		Lag		Lead		
Lead-Lag Optimize?		Yes		Yes		
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	None		Min		None	Min
Act Effct Green (s)	7.0	22.1	37.7		52.7	52.7
Actuated g/C Ratio	0.10	0.33	0.56		0.78	0.78
v/c Ratio	0.80	0.51	0.93		0.90	0.27
Control Delay	64.3	8.8	29.2		44.9	2.6
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	64.3	8.8	29.2		44.9	2.6
LOS	E	A	C	D	A	
Approach Delay	24.8		29.2			22.8

Lanes, Volumes, Timings
7: Concord Avenue & Spring Street

2014 No-Build Conditions
PM Peak Hour

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Approach LOS	C		C			C
90th %ile Green (s)	6.0		39.0		10.0	54.0
90th %ile Term Code	Max		Max		Max	Hold
70th %ile Green (s)	6.0		39.0		10.0	54.0
70th %ile Term Code	Max		Max		Max	Hold
50th %ile Green (s)	6.0		39.0		10.0	54.0
50th %ile Term Code	Max		Max		Max	Hold
30th %ile Green (s)	6.0		39.0		10.0	54.0
30th %ile Term Code	Max		Max		Max	Hold
10th %ile Green (s)	6.0		28.1		10.0	43.1
10th %ile Term Code	Max		Gap		Max	Hold
Queue Length 50th (ft)	65	32	343		103	32
Queue Length 95th (ft)	#143	80	#506		#219	46
Internal Link Dist (ft)	670		920			1445
Turn Bay Length (ft)	210				230	
Base Capacity (vph)	188	725	1164		410	1527
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.80	0.51	0.91		0.90	0.27

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 67.8

Natural Cycle: 70

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 26.1

Intersection LOS: C

Intersection Capacity Utilization 83.3%

ICU Level of Service E

Analysis Period (min) 15

90th %ile Actuated Cycle: 70

70th %ile Actuated Cycle: 70

50th %ile Actuated Cycle: 70

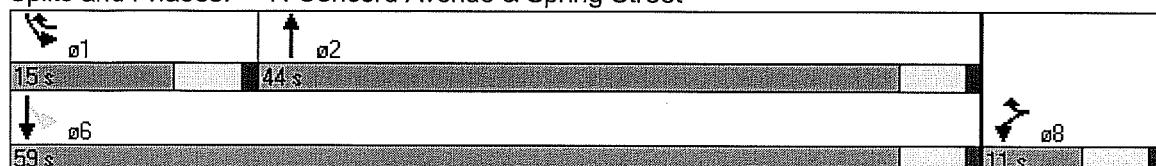
30th %ile Actuated Cycle: 70

10th %ile Actuated Cycle: 59.1

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 7: Concord Avenue & Spring Street



Lanes, Volumes, Timings
8: Marrett Road (Route 2A) & Spring Street

2014 No-Build Conditions
PM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↓	↖	↙	↗	↘
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	13	13
Grade (%)	4%			-1%	0%	
Storage Length (ft)		0	200		0	0
Storage Lanes		0	1		1	0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50	50	50	
Trailing Detector (ft)	0		0	0	0	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.950				0.929	
Flt Protected			0.950		0.977	
Satd. Flow (prot)	1965	0	2016	2122	1747	0
Flt Permitted			0.091		0.977	
Satd. Flow (perm)	1965	0	193	2122	1747	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	27				67	
Headway Factor	0.87	0.87	0.84	0.84	0.96	0.96
Link Speed (mph)	30			30	30	
Link Distance (ft)	1000			1000	2795	
Travel Time (s)	22.7			22.7	63.5	
Volume (vph)	388	229	145	238	415	454
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	426	252	159	262	456	499
Lane Group Flow (vph)	678	0	159	262	955	0
Turn Type		pm+pt				
Protected Phases	2		1	6	8	
Permitted Phases			6			
Detector Phases	2		1	6	8	
Minimum Initial (s)	8.0		6.0	8.0	6.0	
Minimum Split (s)	13.0		11.0	13.0	11.0	
Total Split (s)	44.0	0.0	11.0	55.0	65.0	0.0
Total Split (%)	36.7%	0.0%	9.2%	45.8%	54.2%	0.0%
Maximum Green (s)	39.0		6.0	50.0	60.0	
Yellow Time (s)	4.0		4.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	1.0	1.0	
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Recall Mode	Min		None	Min	None	
Act Effct Green (s)	40.0		51.0	51.0	61.0	
Actuated g/C Ratio	0.33		0.42	0.42	0.51	
v/c Ratio	1.01		0.85	0.29	1.04	
Control Delay	75.2		59.8	23.8	67.6	
Queue Delay	0.0		0.0	0.0	0.0	
Total Delay	75.2		59.8	23.8	67.6	
LOS	E		E	C	E	
Approach Delay	75.2			37.4	67.6	

Lanes, Volumes, Timings
8: Marrett Road (Route 2A) & Spring Street

2014 No-Build Conditions
PM Peak Hour



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Approach LOS	E			D	E	
90th %ile Green (s)	39.0		6.0	50.0	60.0	
90th %ile Term Code	Max		Max	Hold	Max	
70th %ile Green (s)	39.0		6.0	50.0	60.0	
70th %ile Term Code	Max		Max	Hold	Max	
50th %ile Green (s)	39.0		6.0	50.0	60.0	
50th %ile Term Code	Max		Max	Hold	Max	
30th %ile Green (s)	39.0		6.0	50.0	60.0	
30th %ile Term Code	Max		Max	Hold	Max	
10th %ile Green (s)	39.0		6.0	50.0	60.0	
10th %ile Term Code	Max		Max	Hold	Max	
Queue Length 50th (ft)	~516		76	131	~771	
Queue Length 95th (ft)	#772		#187	194	#1025	
Internal Link Dist (ft)	920			920	2715	
Turn Bay Length (ft)			200			
Base Capacity (vph)	673		188	902	921	
Starvation Cap Reductn	0		0	0	0	
Spillback Cap Reductn	0		0	0	0	
Storage Cap Reductn	0		0	0	0	
Reduced v/c Ratio	1.01		0.85	0.29	1.04	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Natural Cycle: 120

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.04

Intersection Signal Delay: 63.9

Intersection LOS: E

Intersection Capacity Utilization 103.3%

ICU Level of Service G

Analysis Period (min) 15

90th %ile Actuated Cycle: 120

70th %ile Actuated Cycle: 120

50th %ile Actuated Cycle: 120

30th %ile Actuated Cycle: 120

10th %ile Actuated Cycle: 120

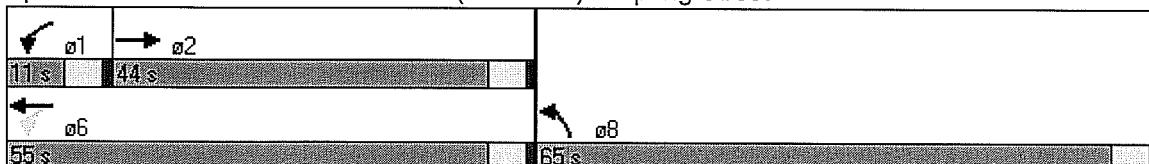
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 8: Marrett Road (Route 2A) & Spring Street



HCM Unsigned Intersection Capacity Analysis
10: Shade Street & Spring Street

2014 No-Build Conditions
PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	4	21	116	844	341	14
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	5	25	138	1005	406	17
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1695	414	423			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1695	414	423			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	96	88			
cM capacity (veh/h)	91	632	1147			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	30	1143	423			
Volume Left	5	138	0			
Volume Right	25	0	17			
cSH	323	1147	1700			
Volume to Capacity	0.09	0.12	0.25			
Queue Length 95th (ft)	8	10	0			
Control Delay (s)	17.3	3.3	0.0			
Lane LOS	C	A				
Approach Delay (s)	17.3	3.3	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay		2.7				
Intersection Capacity Utilization		83.0%		ICU Level of Service		E
Analysis Period (min)		15				

- Build

Lanes, Volumes, Timings
1: Patriot Way & Spring Street

2014 Build Conditions
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	12	16	12	12	12	14	12	12
Grade (%)		2%			5%			4%			-6%	
Storage Length (ft)	70		0	165		145	180		0	190		0
Storage Lanes	1		1	1		1	1		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50	50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.897				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1568	1334	1332	1684	1669	1668	1701	1638	0	1907	1938	1584
Flt Permitted	0.336			0.693			0.098			0.295		
Satd. Flow (perm)	554	1334	1332	1229	1669	1668	175	1638	0	592	1938	1584
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			59			65		201				166
Headway Factor	1.01	1.01	1.01	1.08	1.03	0.88	1.03	1.03	1.03	0.88	0.96	0.96
Link Speed (mph)	30			40			30			30		
Link Distance (ft)	1000			1275			1525			1330		
Travel Time (s)	22.7			21.7			34.7			30.2		
Volume (vph)	42	89	54	261	250	60	455	210	457	203	734	239
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	14%	41%	20%	1%	11%	7%	4%	4%	1%	4%	1%	5%
Adj. Flow (vph)	46	98	59	287	275	66	500	231	502	223	807	263
Lane Group Flow (vph)	46	98	59	287	275	66	500	733	0	223	807	263
Turn Type	Perm		pm+ov	Perm		Free	pm+pt		pm+pt		pm+pt	Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8		Free	2			6		6
Detector Phases	4	4	5	8	8		5	2		1	6	6
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	8.0		6.0	8.0	8.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0		11.0	13.0		11.0	13.0	13.0
Total Split (s)	24.0	24.0	25.0	24.0	24.0	0.0	25.0	55.0	0.0	11.0	41.0	41.0
Total Split (%)	26.7%	26.7%	27.8%	26.7%	26.7%	0.0%	27.8%	61.1%	0.0%	12.2%	45.6%	45.6%
Maximum Green (s)	19.0	19.0	20.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag			Lead			Lead	Lag		Lead	Lag	Lag	
Lead-Lag Optimize?			Yes			Yes	Yes		Yes	Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None	None	None	None		None	Min		None	Min	Min
Act Effct Green (s)	20.0	20.0	45.0	20.0	20.0	90.0	62.0	51.0		44.0	37.0	37.0
Actuated g/C Ratio	0.22	0.22	0.50	0.22	0.22	1.00	0.69	0.57		0.49	0.41	0.41
v/c Ratio	0.37	0.33	0.08	1.05	0.74	0.04	1.05	0.72		0.57	1.01	0.35
Control Delay	40.0	33.1	3.7	105.1	46.4	0.1	81.0	15.0		14.2	63.2	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	40.0	33.1	3.7	105.1	46.4	0.1	81.0	15.0		14.2	63.2	8.3
LOS	D	C	A	F	D	A	F	B		B	E	A

Lanes, Volumes, Timings
1: Patriot Way & Spring Street

2014 Build Conditions
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		26.1			68.3			41.7			43.6	
Approach LOS		C			E			D			D	
90th %ile Green (s)	19.0	19.0	20.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Max		Max	Max	Max
70th %ile Green (s)	19.0	19.0	20.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
70th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Hold		Max	Max	Max
50th %ile Green (s)	19.0	19.0	20.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
50th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Hold		Max	Max	Max
30th %ile Green (s)	19.0	19.0	20.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
30th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Hold		Max	Max	Max
10th %ile Green (s)	19.0	19.0	20.0	19.0	19.0		20.0	50.0		6.0	36.0	36.0
10th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Hold		Max	Max	Max
Queue Length 50th (ft)	22	47	0	~180	146	0	~264	206		39	~462	34
Queue Length 95th (ft)	58	93	19	#335	#260	0	#459	351		63	#711	87
Internal Link Dist (ft)		920			1195			1445			1250	
Turn Bay Length (ft)	70			165		145	180			190		
Base Capacity (vph)	123	296	696	273	371	1668	477	1015		392	797	749
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.37	0.33	0.08	1.05	0.74	0.04	1.05	0.72		0.57	1.01	0.35

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 90

Natural Cycle: 80

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.05

Intersection Signal Delay: 46.5

Intersection LOS: D

Intersection Capacity Utilization 96.6%

ICU Level of Service F

Analysis Period (min) 15

90th %ile Actuated Cycle: 90

70th %ile Actuated Cycle: 90

50th %ile Actuated Cycle: 90

30th %ile Actuated Cycle: 90

10th %ile Actuated Cycle: 90

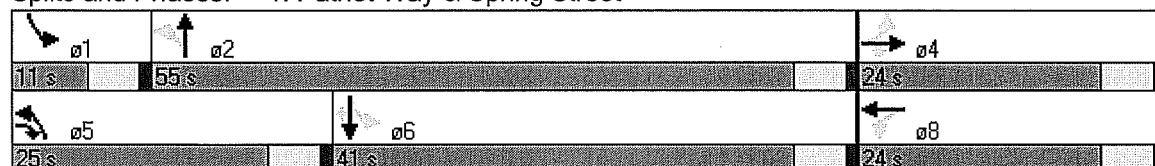
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Patriot Way & Spring Street



Lanes, Volumes, Timings
2: Hayden Avenue & Route 2 WB on-ramp

2014 Build Conditions
AM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↓	↙	↖	↔	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	12	12
Grade (%)	-6%			3%	0%	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.964					
Flt Protected				0.991		
Satd. Flow (prot)	2041	0	0	2061	0	0
Flt Permitted				0.991		
Satd. Flow (perm)	2041	0	0	2061	0	0
Headway Factor	0.81	0.81	0.86	0.86	1.00	1.00
Link Speed (mph)	40			45	30	
Link Distance (ft)	1275			1240	500	
Travel Time (s)	21.7			18.8	11.4	
Volume (vph)	385	141	180	798	0	0
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	1%	15%	2%	2%	0%	0%
Adj. Flow (vph)	423	155	198	877	0	0
Lane Group Flow (vph)	578	0	0	1075	0	0
Sign Control	Free			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 87.5%

ICU Level of Service E

Analysis Period (min) 15

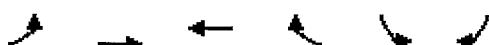
HCM Unsigned Intersection Capacity Analysis
3: Hayden Avenue & 65 Hayden Avenue

2014 Build Conditions
AM Peak Hour

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↖	↗		↖	↗
Sign Control		Free	Free		Stop	
Grade		2%	-2%		-2%	
Volume (veh/h)	166	183	972	40	4	19
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	191	210	1117	46	5	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1163			1732	1140	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1163			1732	1140	
tC, single (s)	4.1			6.4	6.4	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.5	
p0 queue free %	68			93	90	
cM capacity (veh/h)	604			67	225	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	401	1163	26			
Volume Left	191	0	5			
Volume Right	0	46	22			
cSH	604	1700	160			
Volume to Capacity	0.32	0.68	0.17			
Queue Length 95th (ft)	34	0	14			
Control Delay (s)	9.1	0.0	32.0			
Lane LOS	A		D			
Approach Delay (s)	9.1	0.0	32.0			
Approach LOS			D			
Intersection Summary						
Average Delay		2.8				
Intersection Capacity Utilization		85.7%		ICU Level of Service		E
Analysis Period (min)		15				

HCM Unsigned Intersection Capacity Analysis
4: Hayden Avenue & 45 Hayden Avenue

2014 Build Conditions
AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↑		↔	
Sign Control		Free	Free		Stop	
Grade		2%	2%		0%	
Volume (veh/h)	45	142	1006	108	10	6
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	48	151	1070	115	11	6
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1185			1374	1128	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1185			1374	1128	
tC, single (s)	4.1			6.4	6.2	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	92			93	97	
cM capacity (veh/h)	596			149	251	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	199	1185	17			
Volume Left	48	0	11			
Volume Right	0	115	6			
cSH	596	1700	176			
Volume to Capacity	0.08	0.70	0.10			
Queue Length 95th (ft)	7	0	8			
Control Delay (s)	3.6	0.0	27.7			
Lane LOS	A		D			
Approach Delay (s)	3.6	0.0	27.7			
Approach LOS			D			
Intersection Summary						
Average Delay		0.8				
Intersection Capacity Utilization		69.5%		ICU Level of Service		C
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Hayden Avenue & Route 2 WB off-ramp

2014 Build Conditions
AM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑			↑	↖	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16
Grade (%)	1%			-1%	-1%	
Storage Length (ft)		0	0		0	220
Storage Lanes		0	0		1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50			50	50	50
Trailing Detector (ft)	0			0	0	0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850
Flt Protected						0.950
Satd. Flow (prot)	2060	0	0	2143	2036	1803
Flt Permitted						0.950
Satd. Flow (perm)	2060	0	0	2143	2036	1803
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)						547
Headway Factor	0.85	0.85	0.84	0.84	0.84	0.84
Link Speed (mph)	45			40	30	
Link Distance (ft)	1370			555	1000	
Travel Time (s)	20.8			9.5	22.7	
Volume (vph)	137	0	0	526	683	492
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	4%	0%	0%	1%	1%	2%
Adj. Flow (vph)	152	0	0	584	759	547
Lane Group Flow (vph)	152	0	0	584	759	547
Turn Type						Perm
Protected Phases	2			6	8	
Permitted Phases						8
Detector Phases	2			6	8	8
Minimum Initial (s)	8.0			8.0	6.0	6.0
Minimum Split (s)	13.0			13.0	11.0	11.0
Total Split (s)	26.0	0.0	0.0	26.0	34.0	34.0
Total Split (%)	43.3%	0.0%	0.0%	43.3%	56.7%	56.7%
Maximum Green (s)	21.0			21.0	29.0	29.0
Yellow Time (s)	4.0			4.0	4.0	4.0
All-Red Time (s)	1.0			1.0	1.0	1.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Recall Mode	Min			Min	None	None
Act Effct Green (s)	18.5			18.5	24.8	24.8
Actuated g/C Ratio	0.36			0.36	0.48	0.48
v/c Ratio	0.21			0.76	0.78	0.48
Control Delay	13.7			23.7	18.3	2.5
Queue Delay	0.0			0.0	0.0	0.0
Total Delay	13.7			23.7	18.3	2.5
LOS	B			C	B	A

Lanes, Volumes, Timings
5: Hayden Avenue & Route 2 WB off-ramp

2014 Build Conditions
AM Peak Hour



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Approach Delay	13.7			23.7	11.7	
Approach LOS		B			C	B
90th %ile Green (s)	21.0			21.0	29.0	29.0
90th %ile Term Code	Hold			Max	Max	Max
70th %ile Green (s)	21.0			21.0	29.0	29.0
70th %ile Term Code	Hold			Max	Max	Max
50th %ile Green (s)	21.0			21.0	29.0	29.0
50th %ile Term Code	Hold			Max	Max	Max
30th %ile Green (s)	15.5			15.5	21.4	21.4
30th %ile Term Code	Hold			Gap	Gap	Gap
10th %ile Green (s)	9.7			9.7	12.5	12.5
10th %ile Term Code	Hold			Gap	Gap	Gap
Queue Length 50th (ft)	36			179	202	0
Queue Length 95th (ft)	72			#296	328	40
Internal Link Dist (ft)	1290			475	920	
Turn Bay Length (ft)						220
Base Capacity (vph)	834			868	1086	1217
Starvation Cap Reductn	0			0	0	0
Spillback Cap Reductn	0			0	0	0
Storage Cap Reductn	0			0	0	0
Reduced v/c Ratio	0.18			0.67	0.70	0.45

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 51.8

Natural Cycle: 50

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.78

Intersection Signal Delay: 15.3

Intersection LOS: B

Intersection Capacity Utilization 72.2%

ICU Level of Service C

Analysis Period (min) 15

90th %ile Actuated Cycle: 60

70th %ile Actuated Cycle: 60

50th %ile Actuated Cycle: 60

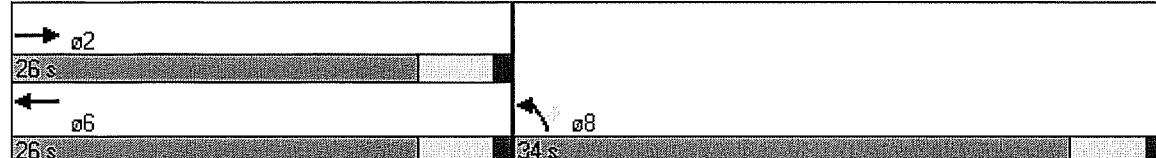
30th %ile Actuated Cycle: 46.9

10th %ile Actuated Cycle: 32.2

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 5: Hayden Avenue & Route 2 WB off-ramp



Lanes, Volumes, Timings
6: Hayden Avenue & Waltham Street

2014 Build Conditions
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	12	12	12	11	16	16	16	16	14
Grade (%)		1%			-1%			2%			-3%	
Storage Length (ft)	0		225	0		0	205		0	0		125
Storage Lanes	0		1	0		0	1		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.932						0.850
Flt Protected			0.950			0.976			0.950			
Satd. Flow (prot)	0	2035	1785	0	1737	0	1710	2090	0	0	2143	1714
Flt Permitted		0.757			0.859		0.100					
Satd. Flow (perm)	0	1622	1785	0	1529	0	180	2090	0	0	2143	1714
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			405		1							172
Headway Factor	0.85	0.85	0.85	0.99	0.99	0.99	1.06	0.86	0.86	0.83	0.83	0.90
Link Speed (mph)		40			30		35					40
Link Distance (ft)		555			200			1000				1000
Travel Time (s)		9.5			4.5			19.5				17.0
Volume (vph)	47	0	580	1	0	1	300	655	0	0	974	225
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	0%	0%	2%	0%	0%	0%	1%	2%	0%	0%	2%	2%
Adj. Flow (vph)	49	0	611	1	0	1	316	689	0	0	1025	237
Lane Group Flow (vph)	0	49	611	0	2	0	316	689	0	0	1025	237
Turn Type	Perm		Free	Perm			pm+pt			Perm		Perm
Protected Phases		4			8		5	2			6	
Permitted Phases	4		Free	8			2			6		6
Detector Phases	4	4		8	8		5	2		6	6	6
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	8.0		8.0	8.0	8.0
Minimum Split (s)	11.0	11.0		11.0	11.0		10.0	13.0		13.0	13.0	13.0
Total Split (s)	11.0	11.0	0.0	11.0	11.0	0.0	14.0	54.0	0.0	40.0	40.0	40.0
Total Split (%)	16.9%	16.9%	0.0%	16.9%	16.9%	0.0%	21.5%	83.1%	0.0%	61.5%	61.5%	61.5%
Maximum Green (s)	6.0	6.0		6.0	6.0		10.0	49.0		35.0	35.0	35.0
Yellow Time (s)	4.0	4.0		4.0	4.0		3.5	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0		0.5	1.0		1.0	1.0	1.0
Lead/Lag							Lead			Lag	Lag	Lag
Lead-Lag Optimize?							Yes			Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	Min		Min	Min	Min
Act Effct Green (s)		7.0	56.6		7.0		46.7	48.8			32.3	32.3
Actuated g/C Ratio		0.11	1.00		0.11		0.83	0.86			0.57	0.57
v/c Ratio		0.26	0.34		0.01		0.74	0.38			0.84	0.23
Control Delay		30.3	0.5		23.0		26.7	2.7			19.5	3.0
Queue Delay		0.0	0.0		0.0		0.0	0.0			0.0	0.0
Total Delay		30.3	0.5		23.0		26.7	2.7			19.5	3.0
LOS		C	A		C		C	A			B	A

Synchro 6 Report
7/20/2009

Lanes, Volumes, Timings
6: Hayden Avenue & Waltham Street

2014 Build Conditions
AM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		2.7			23.0			10.2			16.4	
Approach LOS		A			C			B			B	
90th %ile Green (s)	6.0	6.0		6.0	6.0		10.0	49.0		35.0	35.0	35.0
90th %ile Term Code	Max	Max		Max	Max		Max	Hold		Max	Max	Max
70th %ile Green (s)	6.0	6.0		6.0	6.0		10.0	49.0		35.0	35.0	35.0
70th %ile Term Code	Max	Max		Hold	Hold		Max	Hold		Max	Max	Max
50th %ile Green (s)	6.0	6.0		6.0	6.0		10.0	49.0		35.0	35.0	35.0
50th %ile Term Code	Max	Max		Hold	Hold		Max	Hold		Max	Max	Max
30th %ile Green (s)	0.0	0.0		0.0	0.0		10.0	38.0		24.0	24.0	24.0
30th %ile Term Code	Skip	Skip		Skip	Skip		Max	Hold		Gap	Gap	Gap
10th %ile Green (s)	0.0	0.0		0.0	0.0		9.6	40.2		26.6	26.6	26.6
10th %ile Term Code	Skip	Skip		Skip	Skip		Gap	Dwell		Dwell	Dwell	Dwell
Queue Length 50th (ft)	18	0		0			71	64			314	11
Queue Length 95th (ft)	48	0		6			#202	101			#578	38
Internal Link Dist (ft)	475				120						920	
Turn Bay Length (ft)		225					205					125
Base Capacity (vph)	187	1785		178			428	1801			1286	1097
Starvation Cap Reductn	0	0		0			0	0			0	0
Spillback Cap Reductn	0	0		0			0	0			0	0
Storage Cap Reductn	0	0		0			0	0			0	0
Reduced v/c Ratio	0.26	0.34		0.01			0.74	0.38			0.80	0.22

Intersection Summary

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 56.6

Natural Cycle: 70

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.84

Intersection Signal Delay: 11.2

Intersection LOS: B

Intersection Capacity Utilization 100.7%

ICU Level of Service G

Analysis Period (min) 15

90th %ile Actuated Cycle: 65

70th %ile Actuated Cycle: 65

50th %ile Actuated Cycle: 65

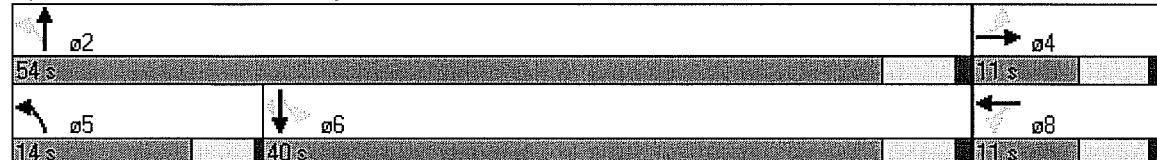
30th %ile Actuated Cycle: 43

10th %ile Actuated Cycle: 45.2

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 6: Hayden Avenue & Waltham Street



Lanes, Volumes, Timings
7: Concord Avenue & Spring Street

2014 Build Conditions
AM Peak Hour

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	14	16	16	13	13
Grade (%)	2%		2%			-2%
Storage Length (ft)	210	0		0	230	
Storage Lanes	1	1		0	1	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850	0.951			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1810	1672	1988	0	1847	1944
Flt Permitted	0.950				0.258	
Satd. Flow (perm)	1810	1672	1988	0	502	1944
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		377	48			
Headway Factor	0.97	0.93	0.86	0.86	0.95	0.95
Link Speed (mph)	35		30			30
Link Distance (ft)	750		1000			1525
Travel Time (s)	14.6		22.7			34.7
Volume (vph)	176	781	210	121	310	716
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	196	868	233	134	344	796
Lane Group Flow (vph)	196	868	367	0	344	796
Turn Type		pt+ov		pm+pt		
Protected Phases	8	8 1	2		1	6
Permitted Phases					6	
Detector Phases	8	8 1	2		1	6
Minimum Initial (s)	6.0		8.0		6.0	8.0
Minimum Split (s)	11.0		13.0		11.0	13.0
Total Split (s)	24.0	39.0	21.0	0.0	15.0	36.0
Total Split (%)	40.0%	65.0%	35.0%	0.0%	25.0%	60.0%
Maximum Green (s)	19.0		16.0		10.0	31.0
Yellow Time (s)	4.0		4.0		4.0	4.0
All-Red Time (s)	1.0		1.0		1.0	1.0
Lead/Lag		Lag		Lead		
Lead-Lag Optimize?		Yes		Yes		
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	None		Min		None	Min
Act Effct Green (s)	16.8	31.6	14.1		28.9	28.9
Actuated g/C Ratio	0.31	0.59	0.26		0.54	0.54
v/c Ratio	0.35	0.76	0.66		0.64	0.76
Control Delay	16.7	10.4	22.6		14.4	16.9
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	16.7	10.4	22.6		14.4	16.9
LOS	B	B	C		B	B
Approach Delay	11.6		22.6			16.2

Lanes, Volumes, Timings
7: Concord Avenue & Spring Street

2014 Build Conditions
AM Peak Hour

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Approach LOS	B		C			B
90th %ile Green (s)	19.0		16.0		10.0	31.0
90th %ile Term Code	Max		Max		Max	Max
70th %ile Green (s)	19.0		16.0		10.0	31.0
70th %ile Term Code	Max		Max		Max	Max
50th %ile Green (s)	19.0		14.6		10.0	29.6
50th %ile Term Code	Max		Gap		Max	Hold
30th %ile Green (s)	15.9		11.5		10.0	26.5
30th %ile Term Code	Gap		Gap		Max	Hold
10th %ile Green (s)	7.8		8.0		7.7	20.7
10th %ile Term Code	Gap		Min		Gap	Hold
Queue Length 50th (ft)	50	92	98		65	207
Queue Length 95th (ft)	98	250	176		#120	#345
Internal Link Dist (ft)	670		920			1445
Turn Bay Length (ft)	210				230	
Base Capacity (vph)	641	1171	636		544	1096
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.31	0.74	0.58		0.63	0.73

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 53.9

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.76

Intersection Signal Delay: 15.2

Intersection LOS: B

Intersection Capacity Utilization 73.5%

ICU Level of Service D

Analysis Period (min) 15

90th %ile Actuated Cycle: 60

70th %ile Actuated Cycle: 60

50th %ile Actuated Cycle: 58.6

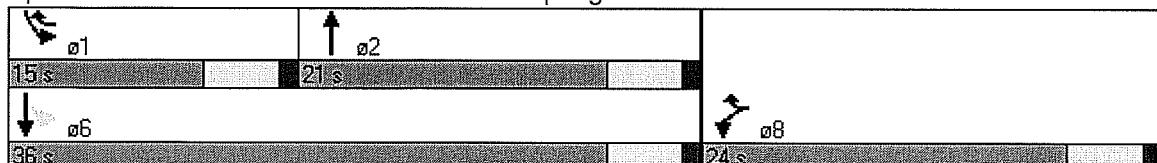
30th %ile Actuated Cycle: 52.4

10th %ile Actuated Cycle: 38.5

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 7: Concord Avenue & Spring Street



Lanes, Volumes, Timings
8: Marrett Road (Route 2A) & Spring Street

2014 Build Conditions
AM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↖	↗	↖	↗	↖
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	13	13
Grade (%)	4%			-1%	0%	
Storage Length (ft)		0	200		0	0
Storage Lanes		0	1		1	0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50	50	50	
Trailing Detector (ft)	0		0	0	0	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.907				0.932	
Flt Protected			0.950		0.976	
Satd. Flow (prot)	1876	0	2016	2122	1751	0
Flt Permitted			0.129		0.976	
Satd. Flow (perm)	1876	0	274	2122	1751	0
Right Turn on Red		Yes			Yes	
Satd. Flow (RTOR)	242				71	
Headway Factor	0.87	0.87	0.84	0.84	0.96	0.96
Link Speed (mph)	30			30	30	
Link Distance (ft)	1000			1000	2795	
Travel Time (s)	22.7			22.7	63.5	
Volume (vph)	287	638	542	397	129	132
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	312	693	589	432	140	143
Lane Group Flow (vph)	1005	0	589	432	283	0
Turn Type		pm+pt				
Protected Phases	2		1		6	8
Permitted Phases			6			
Detector Phases	2		1		6	8
Minimum Initial (s)	8.0		6.0	8.0		6.0
Minimum Split (s)	13.0		11.0	13.0		11.0
Total Split (s)	31.0	0.0	17.0	48.0	12.0	0.0
Total Split (%)	51.7%	0.0%	28.3%	80.0%	20.0%	0.0%
Maximum Green (s)	26.0		12.0	43.0		7.0
Yellow Time (s)	4.0		4.0	4.0		4.0
All-Red Time (s)	1.0		1.0	1.0		1.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Recall Mode	Min		None	Min	None	
Act Effct Green (s)	27.0		44.0	44.0		8.0
Actuated g/C Ratio	0.45		0.73	0.73		0.13
v/c Ratio	1.03		1.02	0.28		0.96
Control Delay	52.4		60.6	3.2		67.3
Queue Delay	0.0		0.0	0.0		0.0
Total Delay	52.4		60.6	3.2		67.3
LOS	D		E	A		E
Approach Delay	52.4			36.3		67.3

Lanes, Volumes, Timings
8: Marrett Road (Route 2A) & Spring Street

2014 Build Conditions
AM Peak Hour



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Approach LOS	D		D	E		
90th %ile Green (s)	26.0		12.0	43.0	7.0	
90th %ile Term Code	Max		Max	Hold	Max	
70th %ile Green (s)	26.0		12.0	43.0	7.0	
70th %ile Term Code	Max		Max	Hold	Max	
50th %ile Green (s)	26.0		12.0	43.0	7.0	
50th %ile Term Code	Max		Max	Hold	Max	
30th %ile Green (s)	26.0		12.0	43.0	7.0	
30th %ile Term Code	Max		Max	Hold	Max	
10th %ile Green (s)	26.0		12.0	43.0	7.0	
10th %ile Term Code	Max		Max	Hold	Max	
Queue Length 50th (ft)	~312		~160	38	77	
Queue Length 95th (ft)	#559		#351	62	#212	
Internal Link Dist (ft)	920			920	2715	
Turn Bay Length (ft)			200			
Base Capacity (vph)	977		578	1556	295	
Starvation Cap Reductn	0		0	0	0	
Spillback Cap Reductn	0		0	0	0	
Storage Cap Reductn	0		0	0	0	
Reduced v/c Ratio	1.03		1.02	0.28	0.96	

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 60

Natural Cycle: 55

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.03

Intersection Signal Delay: 47.1

Intersection LOS: D

Intersection Capacity Utilization 109.6%

ICU Level of Service H

Analysis Period (min) 15

90th %ile Actuated Cycle: 60

70th %ile Actuated Cycle: 60

50th %ile Actuated Cycle: 60

30th %ile Actuated Cycle: 60

10th %ile Actuated Cycle: 60

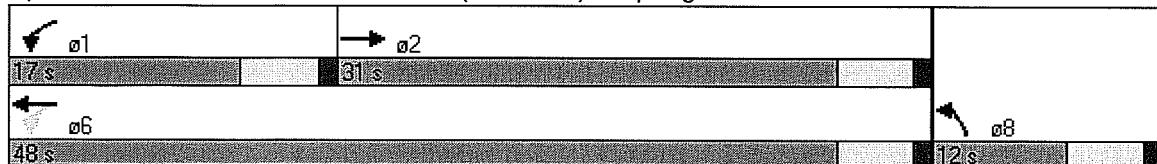
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 8: Marrett Road (Route 2A) & Spring Street



HCM Unsignalized Intersection Capacity Analysis
10: Shade Street & Spring Street

2014 Build Conditions
AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	7	95	29	244	1013	2
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	7	100	31	257	1066	2
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1385	1067	1068			
vc1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	1385	1067	1068			
tC, single (s)	6.5	6.2	4.2			
tC, 2 stage (s)						
tF (s)	3.6	3.3	2.3			
p0 queue free %	95	63	95			
cM capacity (veh/h)	142	272	634			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	107	287	1068			
Volume Left	7	31	0			
Volume Right	100	0	2			
cSH	256	634	1700			
Volume to Capacity	0.42	0.05	0.63			
Queue Length 95th (ft)	49	4	0			
Control Delay (s)	28.9	1.7	0.0			
Lane LOS	D	A				
Approach Delay (s)	28.9	1.7	0.0			
Approach LOS	D					
Intersection Summary						
Average Delay		2.5				
Intersection Capacity Utilization		66.4%		ICU Level of Service		C
Analysis Period (min)		15				

Lanes, Volumes, Timings
1: Patriot Way & Spring Street

2014 Build Conditions
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	11	12	16	12	12	12	14	12	12
Grade (%)		2%			5%			4%			-6%	
Storage Length (ft)	70		0	165		145	180		0	190		0
Storage Lanes	1		1	1		1	1		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50	50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850			0.850		0.959				0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1787	1881	1599	1684	1853	1750	1769	1763	0	1889	1957	1663
Flt Permitted	0.714			0.300			0.514			0.103		
Satd. Flow (perm)	1343	1881	1599	532	1853	1750	957	1763	0	205	1957	1663
Right Turn on Red			Yes			Yes			Yes		Yes	
Satd. Flow (RTOR)			272			192		26			52	
Headway Factor	1.01	1.01	1.01	1.08	1.03	0.88	1.03	1.03	1.03	0.88	0.96	0.96
Link Speed (mph)		30			40			30			30	
Link Distance (ft)		1000			1275			1525			1330	
Travel Time (s)		22.7			21.7			34.7			30.2	
Volume (vph)	181	384	250	179	61	177	89	521	193	49	251	48
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	1%	0%	2%	0%	1%	2%	5%	0%	0%
Adj. Flow (vph)	197	417	272	195	66	192	97	566	210	53	273	52
Lane Group Flow (vph)	197	417	272	195	66	192	97	776	0	53	273	52
Turn Type	Perm		pm+ov	Perm			Free	pm+pt		pm+pt		Perm
Protected Phases		4	5		8			5	2		1	6
Permitted Phases	4		4	8			Free	2			6	
Detector Phases	4	4	5	8	8			5	2		1	6
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0			6.0	8.0		6.0	8.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0			11.0	13.0		11.0	13.0
Total Split (s)	36.0	36.0	11.0	36.0	36.0	0.0	11.0	43.0	0.0	11.0	43.0	43.0
Total Split (%)	40.0%	40.0%	12.2%	40.0%	40.0%	0.0%	12.2%	47.8%	0.0%	12.2%	47.8%	47.8%
Maximum Green (s)	31.0	31.0	6.0	31.0	31.0			6.0	38.0		6.0	38.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0			4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0			1.0	1.0		1.0	1.0
Lead/Lag			Lead				Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?			Yes				Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0	3.0		3.0	3.0
Recall Mode	None	None	None	None	None			None	Min		None	Min
Act Effct Green (s)	32.1	32.1	43.2	32.1	32.1	85.6	43.2	39.2		41.6	34.4	34.4
Actuated g/C Ratio	0.38	0.38	0.50	0.38	0.38	1.00	0.50	0.46		0.46	0.40	0.40
v/c Ratio	0.39	0.59	0.29	0.98	0.09	0.11	0.18	0.95		0.23	0.35	0.07
Control Delay	23.7	26.7	2.7	90.5	19.4	0.1	10.6	45.0		12.5	18.9	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Total Delay	23.7	26.7	2.7	90.5	19.4	0.1	10.6	45.0		12.5	18.9	4.8
LOS	C	C	A	F	B	A	B	D		B	B	A

Lanes, Volumes, Timings
1: Patriot Way & Spring Street

2014 Build Conditions
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		18.6			41.8			41.1			16.1	
Approach LOS		B			D			D			B	
90th %ile Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		6.0	38.0	38.0
90th %ile Term Code	Max	Max	Max	Max	Max		Max	Max		Max	Hold	Hold
70th %ile Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		6.0	38.0	38.0
70th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Max		Max	Hold	Hold
50th %ile Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		6.0	38.0	38.0
50th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Max		Max	Hold	Hold
30th %ile Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		0.0	27.0	27.0
30th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Max		Skip	Hold	Hold
10th %ile Green (s)	31.0	31.0	6.0	31.0	31.0		6.0	38.0		0.0	27.0	27.0
10th %ile Term Code	Hold	Hold	Max	Max	Max		Max	Max		Skip	Hold	Hold
Queue Length 50th (ft)	83	194	0	~120	25	0	24	417		13	99	0
Queue Length 95th (ft)	145	293	40	#253	53	0	47	#677		29	158	20
Internal Link Dist (ft)		920			1195			1445			1250	
Turn Bay Length (ft)	70			165		145	180			190		
Base Capacity (vph)	504	706	941	199	696	1750	549	821		226	848	750
Starvation Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0		0	0	0
Reduced v/c Ratio	0.39	0.59	0.29	0.98	0.09	0.11	0.18	0.95		0.23	0.32	0.07

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 85.6

Natural Cycle: 90

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.98

Intersection Signal Delay: 29.9

Intersection LOS: C

Intersection Capacity Utilization 87.6%

ICU Level of Service E

Analysis Period (min) 15

90th %ile Actuated Cycle: 90

70th %ile Actuated Cycle: 90

50th %ile Actuated Cycle: 90

30th %ile Actuated Cycle: 79

10th %ile Actuated Cycle: 79

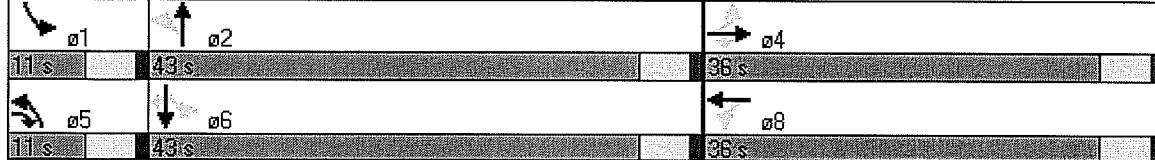
~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Patriot Way & Spring Street



Lanes, Volumes, Timings
2: Hayden Avenue & Route 2 WB on-ramp

2014 Build Conditions
PM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	1			1		
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	12	12
Grade (%)	-6%			3%	0%	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.920					
Flt Protected				0.978		
Satd. Flow (prot)	2016	0	0	2043	0	0
Flt Permitted				0.978		
Satd. Flow (perm)	2016	0	0	2043	0	0
Headway Factor	0.81	0.81	0.86	0.86	1.00	1.00
Link Speed (mph)	40			45	30	
Link Distance (ft)	1275			1240	500	
Travel Time (s)	21.7			18.8	11.4	
Volume (vph)	414	606	288	346	0	0
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	3%	0%	1%	2%	0%	0%
Adj. Flow (vph)	476	697	331	398	0	0
Lane Group Flow (vph)	1173	0	0	729	0	0
Sign Control	Free			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

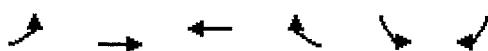
Intersection Capacity Utilization 99.7%

ICU Level of Service F

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
3: Hayden Avenue & 65 Hayden Avenue

2014 Build Conditions
PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↖	↑		↗	↙
Sign Control		Free	Free		Stop	
Grade		2%	-2%		-2%	
Volume (veh/h)	23	400	438	10	49	158
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	25	435	476	11	53	172
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	487				966	482
vC1, stage 1 conf vol						
vc2, stage 2 conf vol						
vCu, unblocked vol	487				966	482
tC, single (s)	4.5				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.6				3.5	3.3
p0 queue free %	97				81	71
cM capacity (veh/h)	905				277	589

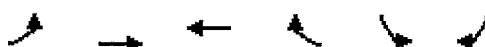
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	460	487	225
Volume Left	25	0	53
Volume Right	0	11	172
cSH	905	1700	465
Volume to Capacity	0.03	0.29	0.48
Queue Length 95th (ft)	2	0	65
Control Delay (s)	0.8	0.0	19.8
Lane LOS	A		C
Approach Delay (s)	0.8	0.0	19.8
Approach LOS			C

Intersection Summary

Average Delay	4.1		
Intersection Capacity Utilization	59.0%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
4: Hayden Avenue & 45 Hayden Avenue

2014 Build Conditions
PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↖	↗		↖ ↗	
Sign Control		Free	Free		Stop	
Grade		2%	2%		0%	
Volume (veh/h)	4	445	406	12	86	42
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93
Hourly flow rate (vph)	4	478	437	13	92	45
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	449				930	443
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	449				930	443
tC, single (s)	4.6				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.7				3.5	3.3
p0 queue free %	100				68	93
cM capacity (veh/h)	898				292	619

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	483	449	138
Volume Left	4	0	92
Volume Right	0	13	45
cSH	898	1700	353
Volume to Capacity	0.00	0.26	0.39
Queue Length 95th (ft)	0	0	45
Control Delay (s)	0.1	0.0	21.6
Lane LOS	A		C
Approach Delay (s)	0.1	0.0	21.6
Approach LOS			C

Intersection Summary

Average Delay	2.8		
Intersection Capacity Utilization	40.6%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings
5: Hayden Avenue & Route 2 WB off-ramp

2014 Build Conditions
PM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↓	↙	↖	↗	↘
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16
Grade (%)	1%			-1%	-1%	
Storage Length (ft)		0	0		0	220
Storage Lanes		0	0		1	1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50			50	50	50
Trailing Detector (ft)	0			0	0	0
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt					0.850	
Flt Protected					0.950	
Satd. Flow (prot)	2121	0	0	2122	2056	1821
Flt Permitted					0.950	
Satd. Flow (perm)	2121	0	0	2122	2056	1821
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)						122
Headway Factor	0.85	0.85	0.84	0.84	0.84	0.84
Link Speed (mph)	45			40	30	
Link Distance (ft)	1370			555	1000	
Travel Time (s)	20.8			9.5	22.7	
Volume (vph)	591	0	0	224	152	288
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	1%	0%	0%	2%	0%	1%
Adj. Flow (vph)	609	0	0	231	157	297
Lane Group Flow (vph)	609	0	0	231	157	297
Turn Type					Perm	
Protected Phases	2			6	8	
Permitted Phases						8
Detector Phases	2			6	8	8
Minimum Initial (s)	8.0			8.0	6.0	6.0
Minimum Split (s)	13.0			13.0	11.0	11.0
Total Split (s)	26.0	0.0	0.0	26.0	34.0	34.0
Total Split (%)	43.3%	0.0%	0.0%	43.3%	56.7%	56.7%
Maximum Green (s)	21.0			21.0	29.0	29.0
Yellow Time (s)	4.0			4.0	4.0	4.0
All-Red Time (s)	1.0			1.0	1.0	1.0
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0			3.0	3.0	3.0
Recall Mode	Min			Min	None	None
Act Effct Green (s)	18.9			18.9	10.6	10.6
Actuated g/C Ratio	0.50			0.50	0.28	0.28
v/c Ratio	0.57			0.22	0.27	0.50
Control Delay	10.0			6.7	11.5	9.7
Queue Delay	0.0			0.0	0.0	0.0
Total Delay	10.0			6.7	11.5	9.7
LOS	A			A	B	A

Lanes, Volumes, Timings
5: Hayden Avenue & Route 2 WB off-ramp

2014 Build Conditions
PM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Approach Delay	10.0			6.7	10.3	
Approach LOS		A		A	B	
90th %ile Green (s)	21.0			21.0	15.8	15.8
90th %ile Term Code	Max			Hold	Gap	Gap
70th %ile Green (s)	19.6			19.6	11.5	11.5
70th %ile Term Code	Gap			Hold	Gap	Gap
50th %ile Green (s)	15.0			15.0	8.6	8.6
50th %ile Term Code	Gap			Hold	Gap	Gap
30th %ile Green (s)	12.0			12.0	6.8	6.8
30th %ile Term Code	Gap			Hold	Gap	Gap
10th %ile Green (s)	22.1			22.1	6.0	6.0
10th %ile Term Code	Dwell			Dwell	Min	Min
Queue Length 50th (ft)	69			21	21	24
Queue Length 95th (ft)	193			65	60	77
Internal Link Dist (ft)	1290			475	920	
Turn Bay Length (ft)						220
Base Capacity (vph)	1159			1159	1088	1021
Starvation Cap Reductn	0			0	0	0
Spillback Cap Reductn	0			0	0	0
Storage Cap Reductn	0			0	0	0
Reduced v/c Ratio	0.53			0.20	0.14	0.29

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 37.7

Natural Cycle: 40

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.57

Intersection Signal Delay: 9.5

Intersection LOS: A

Intersection Capacity Utilization 55.6%

ICU Level of Service B

Analysis Period (min) 15

90th %ile Actuated Cycle: 46.8

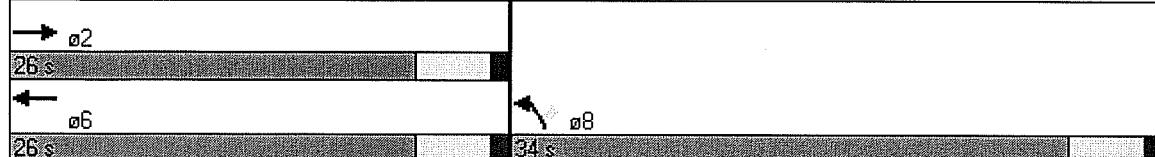
70th %ile Actuated Cycle: 41.1

50th %ile Actuated Cycle: 33.6

30th %ile Actuated Cycle: 28.8

10th %ile Actuated Cycle: 38.1

Splits and Phases: 5: Hayden Avenue & Route 2 WB off-ramp



Lanes, Volumes, Timings
6: Hayden Avenue & Waltham Street

2014 Build Conditions
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	12	12	12	11	16	16	16	16	14
Grade (%)		1%			-1%			2%				-3%
Storage Length (ft)	0		225	0		0	205		0	0		125
Storage Lanes	0		1	0		0	1		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.850		0.865							0.850
Flt Protected		0.953					0.950					
Satd. Flow (prot)	0	2042	1821	0	1652	0	1694	2111	0	0	2164	1714
Flt Permitted		0.729					0.133					
Satd. Flow (perm)	0	1562	1821	0	1652	0	237	2111	0	0	2164	1714
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			535		128							61
Headway Factor	0.85	0.85	0.85	0.99	0.99	0.99	1.06	0.86	0.86	0.83	0.83	0.90
Link Speed (mph)		40			30		35					40
Link Distance (ft)		555			200		1000					1000
Travel Time (s)		9.5			4.5		19.5					17.0
Volume (vph)	222	3	654	0	0	1	162	1014	1	0	688	62
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	1%	0%	0%	1%	2%
Adj. Flow (vph)	231	3	681	0	0	1	169	1056	1	0	717	65
Lane Group Flow (vph)	0	234	681	0	1	0	169	1057	0	0	717	65
Turn Type	Perm		Free	Perm			pm+pt		Perm		Perm	
Protected Phases		4			8		5	2			6	
Permitted Phases	4		Free	8			2			6		6
Detector Phases	4	4		8	8		5	2		6	6	6
Minimum Initial (s)	6.0	6.0		6.0	6.0		6.0	8.0		8.0	8.0	8.0
Minimum Split (s)	11.0	11.0		11.0	11.0		10.0	13.0		13.0	13.0	13.0
Total Split (s)	17.0	17.0	0.0	17.0	17.0	0.0	11.0	43.0	0.0	32.0	32.0	32.0
Total Split (%)	28.3%	28.3%	0.0%	28.3%	28.3%	0.0%	18.3%	71.7%	0.0%	53.3%	53.3%	53.3%
Maximum Green (s)	12.0	12.0		12.0	12.0		7.0	38.0		27.0	27.0	27.0
Yellow Time (s)	4.0	4.0		4.0	4.0		3.5	4.0		4.0	4.0	4.0
All-Red Time (s)	1.0	1.0		1.0	1.0		0.5	1.0		1.0	1.0	1.0
Lead/Lag						Lead			Lag	Lag	Lag	
Lead-Lag Optimize?						Yes			Yes	Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	Min		Min	Min	Min
Act Effct Green (s)		11.9	55.9		11.9		36.0	35.9			27.3	27.3
Actuated g/C Ratio		0.21	1.00		0.21		0.62	0.64			0.49	0.49
v/c Ratio		0.70	0.37		0.00		0.53	0.78			0.68	0.07
Control Delay		34.0	0.6		0.0		12.2	12.5			16.4	3.5
Queue Delay		0.0	0.0		0.0		0.0	0.0			0.0	0.0
Total Delay		34.0	0.6		0.0		12.2	12.5			16.4	3.5
LOS		C	A		A		B	B			B	A

Lanes, Volumes, Timings
6: Hayden Avenue & Waltham Street

2014 Build Conditions
PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		9.1			0.0			12.5			15.3	
Approach LOS		A			A			B			B	
90th %ile Green (s)	12.0	12.0		12.0	12.0		7.0	38.0		27.0	27.0	27.0
90th %ile Term Code	Max	Max		Hold	Hold		Max	Max		Max	Max	Max
70th %ile Green (s)	12.0	12.0		12.0	12.0		7.0	38.0		27.0	27.0	27.0
70th %ile Term Code	Max	Max		Hold	Hold		Max	Max		Max	Max	Max
50th %ile Green (s)	12.0	12.0		12.0	12.0		7.0	35.0		24.0	24.0	24.0
50th %ile Term Code	Max	Max		Hold	Hold		Max	Hold		Gap	Gap	Gap
30th %ile Green (s)	11.1	11.1		11.1	11.1		7.0	29.7		18.7	18.7	18.7
30th %ile Term Code	Gap	Gap		Hold	Hold		Max	Hold		Gap	Gap	Gap
10th %ile Green (s)	7.6	7.6		7.6	7.6		0.0	34.1		34.1	34.1	34.1
10th %ile Term Code	Gap	Gap		Hold	Hold		Skip	Dwell		Dwell	Dwell	Dwell
Queue Length 50th (ft)		73	0		0		20	221			193	1
Queue Length 95th (ft)	#169		0		0		56	372			308	17
Internal Link Dist (ft)		475			120			920			920	
Turn Bay Length (ft)			225				205					125
Base Capacity (vph)		357	1821		477		323	1398			1105	905
Starvation Cap Reductn	0	0		0			0	0			0	0
Spillback Cap Reductn	0	0		0			0	0			0	0
Storage Cap Reductn	0	0		0			0	0			0	0
Reduced v/c Ratio	0.66	0.37		0.00			0.52	0.76			0.65	0.07

Intersection Summary

Area Type: Other

Cycle Length: 60

Actuated Cycle Length: 55.9

Natural Cycle: 60

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.78

Intersection Signal Delay: 12.2

Intersection LOS: B

Intersection Capacity Utilization 118.8%

ICU Level of Service H

Analysis Period (min) 15

90th %ile Actuated Cycle: 60

70th %ile Actuated Cycle: 60

50th %ile Actuated Cycle: 57

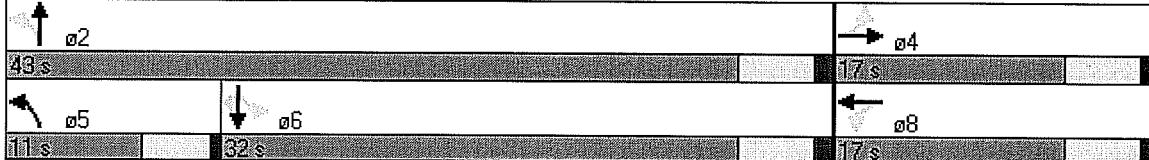
30th %ile Actuated Cycle: 50.8

10th %ile Actuated Cycle: 51.7

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 6: Hayden Avenue & Waltham Street



Lanes, Volumes, Timings
7: Concord Avenue & Spring Street

2014 Build Conditions
PM Peak Hour

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↑ ↗	↑ ↗	↑ ↘	↑ ↘	↑ ↗	↑ ↘
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	14	16	16	13	13
Grade (%)	2%		2%			-2%
Storage Length (ft)	210	0		0	230	
Storage Lanes	1	1		0	1	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50		50	50
Trailing Detector (ft)	0	0	0		0	0
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850	0.944			
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1810	1672	1973	0	1847	1944
Flt Permitted	0.950				0.091	
Satd. Flow (perm)	1810	1672	1973	0	177	1944
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		267	86			
Headway Factor	0.97	0.93	0.86	0.86	0.95	0.95
Link Speed (mph)	35		30			30
Link Distance (ft)	750		1000			1525
Travel Time (s)	14.6		22.7			34.7
Volume (vph)	125	317	513	368	307	347
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	151	382	618	443	370	418
Lane Group Flow (vph)	151	382	1061	0	370	418
Turn Type		pt+ov		pm+pt		
Protected Phases	8	8 1	2		1	6
Permitted Phases					6	
Detector Phases	8	8 1	2		1	6
Minimum Initial (s)	6.0		8.0		6.0	8.0
Minimum Split (s)	11.0		13.0		11.0	13.0
Total Split (s)	11.0	26.0	44.0	0.0	15.0	59.0
Total Split (%)	15.7%	37.1%	62.9%	0.0%	21.4%	84.3%
Maximum Green (s)	6.0		39.0		10.0	54.0
Yellow Time (s)	4.0		4.0		4.0	4.0
All-Red Time (s)	1.0		1.0		1.0	1.0
Lead/Lag		Lag		Lead		
Lead-Lag Optimize?		Yes		Yes		
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	None		Min		None	Min
Act Effct Green (s)	7.0	22.1	37.7		52.7	52.7
Actuated g/C Ratio	0.10	0.33	0.56		0.78	0.78
v/c Ratio	0.80	0.53	0.94		0.90	0.28
Control Delay	64.3	9.3	29.5		44.9	2.6
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	64.3	9.3	29.5		44.9	2.6
LOS	E	A	C		D	A
Approach Delay	24.9		29.5			22.5

Lanes, Volumes, Timings
7: Concord Avenue & Spring Street

2014 Build Conditions
PM Peak Hour

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Approach LOS	C		C			C
90th %ile Green (s)	6.0		39.0		10.0	54.0
90th %ile Term Code	Max		Max		Max	Hold
70th %ile Green (s)	6.0		39.0		10.0	54.0
70th %ile Term Code	Max		Max		Max	Hold
50th %ile Green (s)	6.0		39.0		10.0	54.0
50th %ile Term Code	Max		Max		Max	Hold
30th %ile Green (s)	6.0		39.0		10.0	54.0
30th %ile Term Code	Max		Max		Max	Hold
10th %ile Green (s)	6.0		28.1		10.0	43.1
10th %ile Term Code	Max		Gap		Max	Hold
Queue Length 50th (ft)	65	36	344		103	34
Queue Length 95th (ft)	#143	85	#549		#219	48
Internal Link Dist (ft)	670		920			1445
Turn Bay Length (ft)	210				230	
Base Capacity (vph)	188	725	1164		410	1527
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.80	0.53	0.91		0.90	0.27

Intersection Summary

Area Type: Other

Cycle Length: 70

Actuated Cycle Length: 67.8

Natural Cycle: 70

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.94

Intersection Signal Delay: 26.1

Intersection LOS: C

Intersection Capacity Utilization 83.4%

ICU Level of Service E

Analysis Period (min) 15

90th %ile Actuated Cycle: 70

70th %ile Actuated Cycle: 70

50th %ile Actuated Cycle: 70

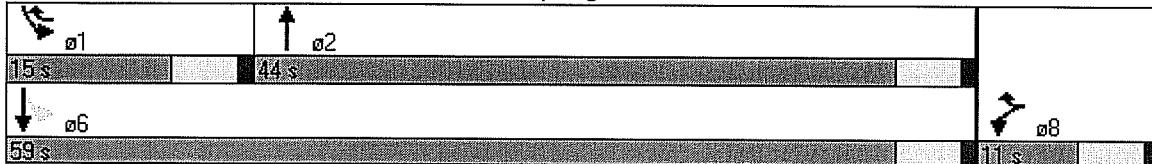
30th %ile Actuated Cycle: 70

10th %ile Actuated Cycle: 59.1

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 7: Concord Avenue & Spring Street



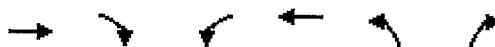
Lanes, Volumes, Timings
8: Marrett Road (Route 2A) & Spring Street

2014 Build Conditions
PM Peak Hour

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↓	↗	↖	↘	↙
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	13	13
Grade (%)	4%			-1%	0%	
Storage Length (ft)		0	200		0	0
Storage Lanes		0	1		1	0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50	50	50	
Trailing Detector (ft)	0		0	0	0	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.949				0.931	
Flt Protected			0.950		0.976	
Satd. Flow (prot)	1963	0	2016	2122	1749	0
Flt Permitted			0.091		0.976	
Satd. Flow (perm)	1963	0	193	2122	1749	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	27				64	
Headway Factor	0.87	0.87	0.84	0.84	0.96	0.96
Link Speed (mph)	30			30	30	
Link Distance (ft)	1000			1000	2795	
Travel Time (s)	22.7			22.7	63.5	
Volume (vph)	388	232	145	238	430	454
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	426	255	159	262	473	499
Lane Group Flow (vph)	681	0	159	262	972	0
Turn Type		pm+pt				
Protected Phases	2		1	6	8	
Permitted Phases			6			
Detector Phases	2		1	6	8	
Minimum Initial (s)	8.0		6.0	8.0	6.0	
Minimum Split (s)	13.0		11.0	13.0	11.0	
Total Split (s)	44.0	0.0	11.0	55.0	65.0	0.0
Total Split (%)	36.7%	0.0%	9.2%	45.8%	54.2%	0.0%
Maximum Green (s)	39.0		6.0	50.0	60.0	
Yellow Time (s)	4.0		4.0	4.0	4.0	
All-Red Time (s)	1.0		1.0	1.0	1.0	
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Recall Mode	Min		None	Min	None	
Act Effct Green (s)	40.0		51.0	51.0	61.0	
Actuated g/C Ratio	0.33		0.42	0.42	0.51	
v/c Ratio	1.01		0.85	0.29	1.06	
Control Delay	76.7		59.8	23.8	73.4	
Queue Delay	0.0		0.0	0.0	0.0	
Total Delay	76.7		59.8	23.8	73.4	
LOS	E		E	C	E	
Approach Delay	76.7		37.4	73.4		

Lanes, Volumes, Timings
8: Marrett Road (Route 2A) & Spring Street

2014 Build Conditions
PM Peak Hour



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Approach LOS	E			D	E	
90th %ile Green (s)	39.0		6.0	50.0	60.0	
90th %ile Term Code	Max		Max	Hold	Max	
70th %ile Green (s)	39.0		6.0	50.0	60.0	
70th %ile Term Code	Max		Max	Hold	Max	
50th %ile Green (s)	39.0		6.0	50.0	60.0	
50th %ile Term Code	Max		Max	Hold	Max	
30th %ile Green (s)	39.0		6.0	50.0	60.0	
30th %ile Term Code	Max		Max	Hold	Max	
10th %ile Green (s)	39.0		6.0	50.0	60.0	
10th %ile Term Code	Max		Max	Hold	Max	
Queue Length 50th (ft)	~525		76	131	~800	
Queue Length 95th (ft)	#775		#187	194	#1056	
Internal Link Dist (ft)	920			920	2715	
Turn Bay Length (ft)		200				
Base Capacity (vph)	672		188	902	921	
Starvation Cap Reductn	0		0	0	0	
Spillback Cap Reductn	0		0	0	0	
Storage Cap Reductn	0		0	0	0	
Reduced v/c Ratio	1.01		0.85	0.29	1.06	

Intersection Summary

Area Type: Other

Cycle Length: 120

Actuated Cycle Length: 120

Natural Cycle: 120

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.06

Intersection Signal Delay: 67.1

Intersection LOS: E

Intersection Capacity Utilization 104.3%

ICU Level of Service G

Analysis Period (min) 15

90th %ile Actuated Cycle: 120

70th %ile Actuated Cycle: 120

50th %ile Actuated Cycle: 120

30th %ile Actuated Cycle: 120

10th %ile Actuated Cycle: 120

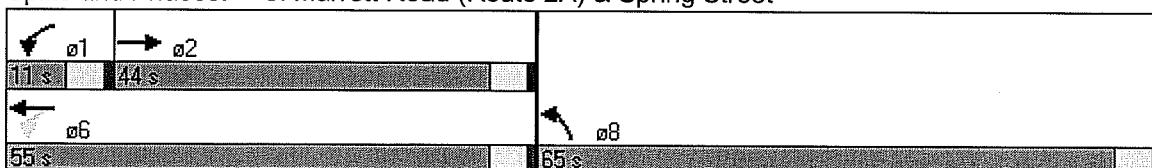
- Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 8: Marrett Road (Route 2A) & Spring Street



HCM Unsignalized Intersection Capacity Analysis
10: Shade Street & Spring Street

2014 Build Conditions
PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Volume (veh/h)	4	21	116	859	344	14
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	5	25	138	1023	410	17
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1717	418	426			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1717	418	426			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	96	88			
cM capacity (veh/h)	88	629	1144			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	30	1161	426			
Volume Left	5	138	0			
Volume Right	25	0	17			
cSH	317	1144	1700			
Volume to Capacity	0.09	0.12	0.25			
Queue Length 95th (ft)	8	10	0			
Control Delay (s)	17.5	3.3	0.0			
Lane LOS	C	A				
Approach Delay (s)	17.5	3.3	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay		2.7				
Intersection Capacity Utilization		83.9%		ICU Level of Service		E
Analysis Period (min)		15				